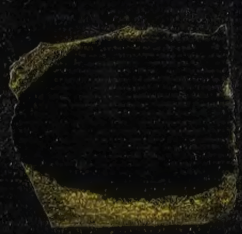

Proceedings

of the

STATEN ISLAND INSTITUTE OF ARTS AND SCIENCES

75th Anniversary

Volume XIX
Number 1
Fall 1956

PROCEEDINGS OF THE
STATEN ISLAND INSTITUTE
OF ARTS AND SCIENCES

Mildred S. Powell, ***Editor***

James L. Whitehead, ***Director***
and Editor of Publications

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THE ISLAND AND THE BAY

Staten Island in Art from 1776 to the Present

AN INTRODUCTORY SURVEY

Done on the occasion of an exhibition from January 13 to March 12, 1957, in celebration of the 75th anniversary of the Staten Island Institute of Arts and Sciences.

By

JAMES L. WHITEHEAD

THE GOLDEN AGE of Staten Island, if it is not yet to come, was undoubtedly the 19th century. Its green hills and quiet valleys and the beauty of its surrounding waters led many people of means and position to establish country homes here and many others to rent cottages or take rooms in the fine hotels for week ends or entire summers. This trend was not confined to bankers, shippers, publishers, or southern planters, but evidently to artists as well. According to Leng and Davis, quoting Webb's Directory for 1882-3, "The atmosphere of the Island seems to be attractive to gentlemen of literary and artistic tastes and pursuits, many of whom have made it their home."[1]

In fact, Staten Island was famous as a tourist attraction as well as a desirable place to live. At one time or another it has been given such titles as "the Newport of New York" and "the American Isle of Wight," and it was not unusual to run across such purple words of praise as those in "Gleason's Pictorial" of Boston, November 27, 1852, which accompanied an engraving of the Narrows:

> "The engraving below represents New York Bay and Harbor, as seen from the Telegraph and Narrows, Staten Island. The view presented by our artist, from this high promontory is truly beautiful; here opens

[1] *Staten Island and its People,* Vol. 1, 313.

from the sea, or lower bay, a fairy scene unsurpassed in all the world, not excepting the Bay of Naples. . . . The whole forms a picture of brilliancy, which defies the painter's pencil or the poet's pen. . . . One or two steamboats leave New York every hour for Staten Island, and are usually crowded; and on gala days from fifteen to twenty thousand persons leave the dust and heat of the city to take a breath of sea air. An omnibus, besides carriages, conveys the people as far as the Telegraph, and the ride from the ferry is delightfully pleasant. On one side are numerous country seats and cottages, built in form like castles and palaces; on the other is the bay, laying [*sic*] like a perfect mirror, with New York behind and the sea in front. Nothing will compare with New York Bay. . . ."

One has only to glance down the list of paintings and drawings to see that the artists of both the 19th and 20th centuries evidently felt the same way and, far from having allowed the beauties of this scene to defy their brushes, seemed to have taken delight in painting our shoreline, the ships and ferries, the Upper and Lower Bays, the Narrows—especially the Narrows—over and over again. If the exhibition seems to be more of a marine display than a well-balanced picture of Staten Island, it is clearly because the artist has been so fascinated with our waterways that he has seldom been able to turn his back and look inland. And perhaps this leaves the right impression, anyway, for Staten Island has taken much of its character and much of its living, at least until recent years, from the waters around it; and even now the great majority of Staten Islanders spend a large part of their lives on the ferries which ply back and forth.

It was only natural that this sylvan isle, so near to the city, should attract permanent residents as well as visitors from the world of art and should even produce a few native artists of its own. Miss Dorothy Smith, in her article, "Staten Island Artists," in *The Staten Island Historian,* July, 1939, listed a surprisingly large number of prominent and near-prominent artists who have made their homes here. It would be pointless to list them all again, but it seems a good idea to comment on the more significant ones, especially to explain why some have been included and others omitted from this exhibition.

Those included from her list are Jasper Cropsey (Staten Island's most famous native artist), C. Winter, Fred W. Kost, Henry Schnakenberg, Ernest Beaumont, Otto C. Wigand, and Gilmer Petroff—all highly respected artists who painted the Staten Island scene many times. The others from her list were omitted for two principal reasons: (1) because of limited space it was impossible

to include more than a small number of the many good artists who have painted Staten Island; and (2) quite a number were not landscape painters at all. For instance, William Page, who lived in Richmond Valley from 1860 to his death in 1885, was famous for his portraits and historical and Biblical scenes; Alfred Turner and Robert Hallowell, also, were portrait painters;[2] Ernest Heineman, wood engraver, and Ernest Roth and Frances Soule Campbell, etchers, were not known as painters at all; William A. Rogers, Charles Broughton, and others were illustrators or cartoonists; and George T. Brewster was one among several prominent sculptors. The original paintings of E. W. Clay and W. J. Bennett for their famous prints of Staten Island in the first half of the 19th century are not now known to exist; and Rockwell Kent, who lived on Staten Island from 1915 to 1917,[3] admitted in correspondence with the author that during these years he was so busy earning a living and completing his Newfoundland paintings from an earlier trip he had no time left for painting Staten Island.

One of the few artists not discovered by Miss Smith is Albert Thompson Bricher, a very successful marine painter in his day who lived in New Dorp from 1894 until his death in 1908. The question that will be asked immediately, of course, is why one of his paintings does not appear in this exhibition.[4] The answer comes as a considerable shock from Mrs. A. O. Ingram, his daughter, who now lives in Great Kills. She told the author that, so far as she knows, her father never did a single painting of Staten Island. He spent each summer along the New England or Long Island coast and then spent the winter painting what he had seen.

Although all these resident artists, plus two more not mentioned by Miss Smith—Ben Benn and Guy Pène du Bois—add up to quite a respectable number for a scattered and predominantly rural community, there has never been an artists' "colony" or an art tradition on Staten Island. Perhaps the artists were like the many literary figures also living here who, in the words of Virgil Markham ". . . sought a quiet, bucolic place, most of them, where they could live in a green shade and yet be within an hour of Broadway.

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[2] Still another, whom Miss Smith does not mention, is Wyatt Eaton (1841-96) who achieved national and international eminence. He is mentioned in Leng and Davis, Vol. I, p. 314, as living on Staten Island.

[3] For an account of this period see Mr. Kent's autobiography, *It's Me O Lord*, pp. 303-322.

[4] Three of his paintings, however, are on display in the Museum's Feature-of-the-Month alcove for the same period as this exhibition.

Where, too, they could get away from each other. . . . I must lose no time in adding that this arrangement was probably for the best, and that for a number of reasons Staten Island benefited those who came here for quiet, refreshment, and solitude."[5]

Be that as it may, Staten Island has sheltered its fair share of artists and, up until the first World War, perhaps, has lured more than its fair share of artist visitors to paint its beautiful shores. It is with these visitors, as much as with the residents, that this survey is concerned. Because of them the Narrows alone must have been as well known among art-lovers during the 19th century as Provincetown, Woodstock, or New Hope have been during the 20th.

Except for one fairly large gap, from the Archibald Robertson drawings of 1777 to the Thomas Birch painting of 1827, our exhibition presents good examples of work by nearly fifty artists, neatly spaced in time from 1776 to the present. The fact that we could not go back any earlier and could not fill the gap mentioned is best explained, perhaps, by the fact that an extensive interest in landscape painting did not develop in this country until well into the 19th century. On Staten Island, as elsewhere, portraits were cherished even as early as the late 17th century[6] and all through the 18th, but the Warren water color seems thus far to be the earliest painting of any significance in which Staten Island is the subject.

The job of tracing these paintings down, however, is far from complete, for the printed record and clues of various kinds show that many other significant Staten Island paintings exist, if only they could be found, and that many artists, in addition to those listed, have certainly or probably painted here, if only their work could be identified.

It is especially tantalizing to read that such paintings as these have been exhibited and sold to private collectors in the past: R. F. Gignoux, "Staten Island, from Brooklyn"; two scenes of Todt Hill by Jasper Cropsey; John William Hill, "The Corners,

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[5] "Literary Tradition on Staten Island," *The Staten Island Historian,* October-December, 1956.

[6] The Institute has, among others, in its own collections a very fine portrait by an unknown artist of Marie Louise Lecoq from the late 17th or early 18th century.

Staten Island"; James Buttersworth, "The Narrows, Home-bound Shipping"; and Thomas Thompson, "View from the Beach below Fort Hamilton."[7]

It is even more disappointing not to find any of the Staten Island paintings by Guy Pène du Bois, who is as closely identified with the Island as any other nationally prominent artist who ever painted here. He lived on Staten Island from 1898 to 1924 and, although he is famous for figure studies rather than landscapes, he has always had great affection for the Staten Island countryside and has painted it a number of times. Even with help from him and his daughter Yvonne, both of whom have only recently come back to this country from Paris, we could not trace any of the Staten Island studies known to exist. Four of these are "The Lake," which was in the first Whitney Biennial Exhibition in 1932; "Lower Bay," which was reproduced in his autobiography, *Artists Say the Silliest Things;* "On Staten Island"; and "Firehouse, West Brighton." This, I believe, represents the only really serious omission in the exhibition, and any information about them or other paintings would be most welcome.*

Our clues lead us to believe that after the turn of the century a number of very prominent painters of the famous group of Eight came to Staten Island, but as yet no paintings with Staten Island place-names, or any other positive identification, except for John Sloan, have turned up. Arthur B. Davies, however, another member of the Eight, exhibited his work at the Staten Island Museum,[8] although, with his interest in the idyllic and visionary, it is understandable why few landscapes of any sort can now be found.

Guy Pène du Bois recalled in correspondence with the author that Jerome Myers,[9] Arnold Freedman, and Gifford Beal have all painted on Staten Island; but unfortunately, like the wash drawing

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[7] Various pages in the alphabetical listing of artists in *National Academy of Design Exhibition Record, 1826-1860* published in 1943 by the New York Historical Society.

[8] Ida Dudley Dale, "From a Diary of 1913." *Proceedings of the Staten Island Institute of Arts and Sciences,* Vol. XV, No. 1 (Spring 1953), p. 33.

[9] Jerome Myers, according to *The Museum Bulletin of the Staten Island Association of Arts and Sciences,* No. 56, March, 1913, also exhibited here.

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* N.B.—I am happy to say that at the last moment after the main body of type had been set, we discovered an important Staten Island painting by Mr. du Bois. It is "The Park," listed as No. 41 in the catalogue.—J.L.W.

by Boardman Robinson of eight figures on the Staten Island ferry reproduced in Albert Christ-Janer's biography of that artist,[10] nothing from these gentlemen has been found.

This all seems to add up to a very sad story indeed, but one's disappointment over the missing artists is considerably lessened in noting the presence of the many excellent 19th century artists and such 20th century figures as John Sloan, Ben Benn, Henry Schnakenberg, Alexander Brook, John Marin, Julio de Diego, and Reginald Marsh.

Even more significant, though, than the fact that a number of famous painters from elsewhere may or may not have come to Staten Island is the appearance of a strong organized amateur movement on Staten Island in the first decade of the 20th century. This movement, centered in the Staten Island Museum and led by a few professionals and a number of the talented amateurs themselves, sponsored exhibitions which improved taste, increased knowledge, raised standards, and developed the enthusiastic group of painters that has come right down to the present day as the Institute's Section of Art.

Some of these painters, together with a few who have had no connection with the Museum, are included in this survey. The record may not as yet be a distinguished one, but it is a highly respectable one. In view of the obvious rise in the level of technical competence and imagination in recent years, I think we have every reason to believe that Staten Island's artistic future may be very bright indeed. And if we can persuade the many fine artists of the New York region once more to investigate Staten Island for subject matter,[11] as their predecessors did, we can expect our eminently paintable island—which now offers greater interest and variety along with its scenery than it ever did in its bucolic heyday—to become as well known to art lovers of the future as it once was to 19th century excursionists.

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10 *Boardman Robinson,* University of Chicago Press, 1946.

11 This movement had a fine beginning at the Museum's "painting bee" on October 20, 1956, when 26 outstanding artists spent the day painting on Staten Island. The results of this work form a companion exhibition to the one for which this article is an introduction.

CATALOGUE

C. T. Warren, "British Fleet off Staten Island, July, 1776"
Courtesy, The Mariners Museum News, Newport News, Va. (No. 1)

CHARLES TURNER WARREN (1767-1823)

1. **British Fleet off Staten Island,** July 3, 1776
Water color. Mariners Museum, Newport News, Virginia

One of a series of 254 water color drawings of naval engagements involving American ships. The series, known as the Bailey Collection, was obtained in England, but its origin is something of a mystery. The drawings are attributed to Charles Turner Warren, well known London engraver, and/or his son Alfred William Warren. It is assumed the series was made to illustrate an unpublished history of the United States Navy.

ARCHIBALD ROBERTSON (c. 1745-1813)

2. **View of the Narrows between Long Island and Staten Island**
3. **View from Staten Island,** July 2, 1777
4. **Taken from the Heights above the Watering Place, Staten Island**
Three drawings. Spencer Collection, New York Public Library

The artist served with the British headquarters troops during the American Revolution, acting as an engineer officer and later as Deputy Quartermaster General. During his service in America he made many drawings of American scenes, notably the series of 54 which now constitute the Spencer Collection—the most important collection of American Revolutionary views in existence.

THOMAS BIRCH (1779-1851)

5. **New York Harbor from the Battery,** 1827
Oil on wood. Museum of the City of New York

First a Philadelphia engraver, Birch later turned his attention to marine painting, perhaps after a visit to the Delaware capes in 1807. The War of 1812 inspired him to paint a series of naval engagements, which made him famous, and for the rest of his life he painted the simple, transparent, romantic marines, "using light and air to create the calm distances which are the most attractive feature of his work."[12]

Thomas Birch, "New York Harbor from the Battery, 1827"
Courtesy, Museum of the City of New York (No. 5)

ARTIST UNKNOWN

6. **View of the Narrows from Fort Hamilton,** c. 1830
Oil on canvas. Mrs. Robert C. Stanley, Staten Island

This delightful primitive, in view of the twenty-four stars on the flag, was evidently painted between the years 1821 and 1836. It clearly shows the green wilderness that was Staten Island at this period, broken only by the villages along the shore, Fort Richmond at the water's edge, the buildings of Fort Tompkins and the Telegraph Station above, and an occasional house or two along the ridge. The view from the Brooklyn side of the Narrows was evidently popular, too. There is a painting showing an almost identical view, also by an unknown artist, in the collections of the Old Print Shop; and No. 15 in this exhibition depicts a similar view.

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[12] E. P. Richardson, *Painting in America,* New York, 1956, p. 156.

THOMAS CHAMBERS (active 1835-1855)

7. **Staten Island and the Narrows,** c. 1835-1840
Oil on canvas. Brooklyn Museum

Chambers, who worked chiefly around New York and Boston, is an early landscape painter who applied the artisan's technique of clear outlines, flat bright colors, and boldly stylized drawing to his landscapes—a fact which explains perhaps the appeal of his work to twentieth century taste.[13]

JAMES E. BUTTERSWORTH (1817-1894)

8. **Governor's Island,** 1835
Oil on canvas. Staten Island Historical Society

Buttersworth, whose name is frequently spelled (even by the artist) without the "s," was an Englishman from the Isle of Wight, who found success in the United States through the rising demand, especially in the prosperous 1870's, for yacht portraits. After his arrival in 1832 in this country he settled in West Hoboken, N. J., where he earned his living by painting marine scenes, many of which were bought and lithographed by Currier and Ives.

GUNTHER HARTWICK (active New York, c. 1835-1857)

9. **New York Bay from the Telegraph Station,** c. 1835-1840
Oil on canvas. Gerald C. Paget, Manhattan

This little known artist was listed as a landscape painter in the New York City Business Directory of 1848, and he exhibited landscapes at the American Union Exhibition, 1849, and at the National Academy of Design, 1857. The painting shows the clear line of vision between Manhattan, seen in the far distance, and the famous telegraph, which signaled to the Merchants Exchange, Wall Street, the arrival of vessels off Sandy Hook.

A. DE GROOT

10. **A View near the Telegraph at the Narrows,** 1846
Wash drawing. Staten Island Historical Society

The artist seems to be unknown, which is unfortunate in view of the charm of the drawing.

ARTIST UNKNOWN

11. **View of Staten Island,** c. 1850
Oil on canvas. R. G. Clifton, Franklin, N. H.

This painting illustrates perfectly the attraction which the rural beauty of Staten Island, with its vistas of the water, held for artists all through the 19th century.

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[13] Richardson, p. 208.

AUGUST KOLLNER (1813- ?)

12. **Six drawings of Staten Island buildings,** c. 1850
The Edward C. Arnold Collection, Metropolitan Museum of Art
Lent through the Museum of the City of New York

The artist, born in Germany, came to this country at least as early as 1839 and settled in Philadelphia. He produced a large number of drawings, mostly wash and sepia, of American cities and scenery, many of which were published as lithographs.

ALEX MATHEW

13. **Oystering at Prince's Bay,** 1850
Oil on canvas. Staten Island Historical Society

Nothing whatsoever seems to be known about the artist who painted this delightful primitive. It has great historic interest, as well as artistic, because it records a detail of the great oyster industry which flourished for many years on Staten Island.

C. WINTER

14. **Village of Richmond,** 1851
Oil on canvas. Staten Island Institute of Arts and Sciences

This view of the old county seat of Staten Island shows the classic portico of the courthouse and the beautiful spire of St. Andrew's church as it appeared before the present church was built in 1868. The artist, except for his name, is unknown. On page 342 of Volume III of William Dunlap's *The Art of Design*, Boston, 1918, there is a listing for G. Winter, who was active in New York in the 1830's but the signature on this one and on another by the same artist in the Institute's collection, "Old Mill at Richmond," seems definitely to show a "C" rather than a "G." It is entirely possible that both paintings were done by a talented amateur rather than by a listed professional.

FRANCES FLORA PALMER (1812-1876)

15. **Fort Hamilton and Fort Lafayette, the Narrows, New York Harbor,** 1855
Water color. New York Historical Society

The painter of this picture, often known as "Fanny" Palmer, did many originals for the famous Currier and Ives prints. On the Staten Island shore in the distance is Fort Richmond, now Fort Wadsworth.

ARTIST UNKNOWN

16. Richmond
17. Mariners Harbor
18. Factoryville

Three water colors, c. 1860. New York Historical Society

These are typical of the many such 19th century drawings made by amateurs all over the United States.

Jasper F. Cropsey, "Grimes Hill, Staten Island"
Courtesy, Brooklyn Museum (No. 19)

JASPER F. CROPSEY (1823-1900)

19. **Grimes Hill, Staten Island,** 1866
Oil on canvas. Brooklyn Museum

20. **Proposed Church at Rossville, Staten Island,** 1845
Water color. Mr. and Mrs. William Steinschneider, Hastings, N. Y.

Born in Rossville, Staten Island, Jasper F. Cropsey was the first native of Staten Island to achieve an international reputation in art. Honored both at home and abroad, especially for his early paintings, but also to some extent for his work as an illustrator and architect, he traveled widely and numbered many of the literary great among his friends. When he returned in the 1850's from his first trip to Europe he settled in New York, painting the surrounding countryside, including Greenwood Lake, N. J., near which he built a house in 1870; but eventually he moved to Hastings-on-Hudson and lived there in a charming house overlooking the river until his death. The small painting which represents him in this exhibition shows his love of the intimate, cozy, rural scene—one extreme of his work—while the great painting, "View from Todt Hill," which hangs permanently in the stair hall of the Staten Island Museum, shows his love of the magnificent panorama. The drawing is of great interest, since it is a rare witness to his considerable architectural ability. Unfortunately, the design for the church, which still stands, was changed a good bit before it was actually built.

WILLIAM FREDERICK DE HAAS (1830-1880)

Oil on canvas. Staten Island Institute of Arts and Sciences

21. **View of the Narrows,** c. 1870
The artist, born in Rotterdam in 1830, settled in New York in 1854, where he taught art and spent many hours painting the coastal regions of the New York area. During the last ten years of his life he painted the Atlantic seaboard from Nova Scotia to Georgia.[14]

HERMANN N. FÜCHSEL (1833-1915)

22. **View of the Narrows** (looking north), 1873
Oil on canvas. Staten Island Institute of Arts and Sciences

Born in Braunschweig, Germany, in 1833, Füchsel came to New York in 1858, where he worked for *Palette,* a magazine devoted to art. This is one of a pair of paintings acquired by the Institute in 1954. The other is a companion view looking south. Shown here is "St. Mary's church on the right, with the New York skyline picked out by the sun in the far background. On the extreme left

[14] See the article by Gerald Bernstein, "Recent Accessions to Our Painting Collections," in the *Proceedings of the Staten Island Institute of Arts and Sciences,* Vol. XV, No. 2 (Fall 1953), p. 68.

is a building which probably is the Mariners' Family Asylum. Füchsel probably painted both from a position on a hill in Rosebank such as the one on which St. Joseph's Hill Academy stands."[15]

ABRAM HOSIER (active 1860-1880)

23. **The Billopp House,** 1873
Water color. New York Historical Society

This sketch is typical of many done by unidentified or unknown artists of some degree of training who loved the quiet beauty of the 19th century American countryside. Nothing is known of Abram Hosier except that he did numerous such sketches in the New York area.

WILLIAM R. MILLER (1818-1893)

24. **Britton's Mill, Staten Island,** and **Watermill, Staten Island,** 1877
25. **Winter Scene, Staten Island,** 1880
26. **Staten Island from Union Hill, N. J.,** 1881
Pen and ink drawings. New York Historical Society

An English artist who came to this country in 1844 or 1845, Miller was a careful and conscientious delineator of landscape and an extreme "Romantic" in presentation. Many of his sketches were probably intended for his proposed but never published, *1000 Gems of American landscape.*[16] The artist is of special interest to Staten Island because his son, Captain Thomas I. Miller, lived in Annadale for many years and was closely associated with the Staten Island Museum because of his interest in microscopy and mineralogy.

W. PARIS

27. **The Narrows,** 1882
Water color. Staten Island Institute of Arts and Sciences

It has been impossible, thus far, positively to identify the artist who did this excellent sketch. One possibility is that he may have been Walter Paris, the water color painter, born in England, who died in Washington, D. C., in 1906.[17]

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[15] Gerald Bernstein, "Art Notes," *Proceedings of the Staten Island Institute of Arts and Sciences,* Vol. XVI, No. 2 (Fall 1954), p. 87.

[16] Bartlett Cowdrey, "Romantic American Watercolors, Our December Exhibition," *The Old Print Shop Portfolio,* New York, N. Y., Vol. IV, Dec., 1944, p. 95; and Donald A. Shelley, "William R. Miller: Forgotten 19th Century Artist," *American Collector,* November, 1947, p. 16.

[17] Mantle Fielding, *Dictionary of American Painters, Sculptors, and Engravers,* New York, 1945, p. 269.

EDWARD MORAN (1829-1901)

28. **Staten Island from New York Bay,** 1883
Oil on canvas. Staten Island Institute of Arts and Sciences

Edward, the older brother of the painter Thomas Moran, was born in England. In 1844 he came to the United States, settling in New York in 1872. This clean fresh painting of the Upper Bay is typical of his work, which is dominated by his interest in the sea. One of his largest projects was a series of historical paintings from Leif Ericson to the War of 1812, which were given by Theodore Sutro to the Pennsylvania Academy of Fine Art.

FREDERICK W. KOST (1861-1923)

29. **Clifton by Moonlight,** c. 1897
Oil on canvas. Mrs. Edwin A. Stumpp, Staten Island

A resident of Staten Island from 1867 to 1900, Frederick W. Kost was one of the most highly respected painters of his day. He had excellent training under George Innes and R. H. Marcy and in Paris and Munich, but his retiring nature delayed recognition of his work. However, he received medals in 1901 and 1904 from the Pan American Exposition in Buffalo and the St. Louis Exposition. He was a member of the National Academy, of the Lotos and Century Clubs, and of the Pennsylvania Academy of Fine Arts, and a year after his death the Brooklyn Museum held a memorial exhibition of his work. "A re-examination of his work shows him to be very capable, with many of the qualities which have brought lasting reputations to his contemporaries George Innes, Homer Martin, and Alexander Wyant."[18]

OTTO C. WIGAND (1856-1944)

30. **Shoreline at Clifton,** c. 1905
Oil on canvas. Robert C. Wigand, Jr., Staten Island

Mr. Wigand was born in Manhattan and studied at the Art Students' League and the Julian Academy in Paris, where he met his wife, Adeline Albright Wigand, a prominent painter of portraits. They established a home on Staten Island around 1914, where they took a leading part in the art activities of the community. Mr. Wigand was elected in 1935 as the first president of the Staten Island Art Association, the predecessor of the present Section of Art of the Staten Island Museum.

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[18] Jean Leason, "Frederick W. Kost, Staten Island Artist," *Proceedings of the Staten Island Institute of Arts and Sciences,* Vol. XI, No. 2 (Jan. 1949), pp. 50-55.

John Sloan, "The Wake of the Ferry"
Courtesy, The Phillips Collection, Washington, D. C. (No. 31)

JOHN SLOAN (1871-1951)

31. **The Wake of the Ferry,** 1907
Oil on canvas. Phillips Gallery, Washington, D. C.

32. **South Beach Bathers,** 1908
Oil on canvas. Walker Art Center, Minneapolis, Minn.

One of the greatest American painters, unappreciated in the early years of his life, John Sloan has steadily risen in the opinion of the public and art critics alike. The two handsome paintings in this exhibition are examples of his finest work. The misty ferry scene, with its low-keyed colors and air of brooding mystery, shows his ability to communicate moods and emotions; the sunny beach scene is more typical—emphasizing as it does his love of people and their everyday work or play. Beginning his career in Philadelphia as an illustrator for the *Philadelphia Press,* Sloan found his life work when he moved to New York in 1904. For the rest of his life he walked its streets, studied its people, and painted what he saw with a humor, directness, and spontaneity that has not since been equaled.[19]

[19] For the best account of his life and work see Lloyd Goodrich, *John Sloan,* Whitney Museum of American Art, New York, 1952.

HELEN E. CLEAVES (1878-)

33. **The Cortelyou House,** 1917
Pencil drawing. Staten Island Institute of Arts and Aciences

Born in Rockford, Illinois, the artist was trained in Boston and for many years was the only woman ever to be appointed Art Director in the Boston school system. Although she has never lived on Staten Island, she has visited her family in Prince's Bay frequently and has spent much time in drawing and painting the old buildings, streams, and woods of the South Shore.

BEN BENN (1884-)

34. **Margaret of Clar Manor, Arrochar,** 1919
Oil on canvas. Lent by the artist

Ben Benn, now one of the nation's top-flight artists, whose paintings hang in many of our greatest museums, lived on Staten Island with his young bride during the years 1918 to 1921, part of the time in Clar Manor, a large Gothic revival house on Cleveland Avenue, now a school for girls. They felt the need for clean country surroundings and are still full of stories of the pleasant life they led and the amusing people they knew. This, the only portrait in the exhibition, was chosen, rather than one of several landscapes available, both because of its artistic merits and because of the fresh rural vigor shown in the girl's glowing cheeks and the green landscape behind her.

HENRY SCHNAKENBERG (1892-)

35. **Frogging,** 1919
Oil on canvas. Staten Island Institute of Arts and Sciences

This nostalgic scene of the pond at Shore Acres illustrates a happy era which is passing all too quickly as Staten Island changes into a city. Mr. Schnakenberg, a native of Staten Island and a distinguished painter who now lives in Connecticut, has done some of his "most appealing work in his intimate studies of natural forms, such as lichen, moss, leaves, and roots which emphasize the artist's love of natural forms and sensitive observation."[20] He has not painted on Staten Island, however, since the early 1920's, and he has not lived here since he left at 21 to study art under Kenneth Hayes Miller. His paintings now hang in many private collections and in such public institutions as the Pennsylvania Academy of Fine Arts, the Wadsworth Athenaeum, the Whitney Museum of American Art, and the Minneapolis Art Institute.

[20] Gerald Bernstein, "Henry E. Schnakenberg," a biographical sketch in the catalogue of the retrospective exhibition given at the Staten Island Museum, Jan. 18-Feb. 24, 1953.

Alexander Brook (1898-)

36. **Beach Houses,** 1924
Oil on canvas. Rehn Gallery, New York City

37. **Trolley Car on Staten Island,** 1934
Oil on canvas. Lent by the artist

Like so many of the younger artists in the years following World War I, Alexander Brook was encouraged by the Whitney Studio Club, forerunner of the Whitney Museum, and he has gone on to become one of the "deans" of American painting, with many prizes and awards to his credit. His work has always been characterized by warm human qualities, wit, rich color, and a subtle and graceful style.

"Beach Houses," once part of a larger painting cut in two by the artist, was acquired by the Whitney Museum and then traded back to the artist for something else. Mr. Brook does not remember the exact spot near South Beach where he went to paint the scene with a friend, David Morrison, who owned a "Model T."

To paint the bouncy little scene of the trolley car, Mr. Brook went this time to Staten Island with a lady friend in a town car driven by a chauffeur named "Tunis."

Henry Schnakenberg, "Frogging"
Staten Island Institute of Arts and Sciences (No. 35)

ERNEST BEAUMONT (1871-1933)

38. **The Brook near the Christopher House,** 1928
Oil on canvas. Staten Island Institute of Arts and Sciences

Mr. Beaumont was born in England, where he received his early art training and where he exhibited his work in a number of galleries. He and his family came to this country and Staten Island in 1907, where both he and his wife became prominent in art activities. His work was acclaimed by the National Academy of Design and the Water Color Society of America, and he was commissioned by the Museum of the City of New York to paint the backgrounds for several of their well known dioramas. Staten Island, Woodstock, N. Y., and Gloucester, Mass., were his favorite subjects. The painting shown was only recently presented to the Museum by his widow.

JOHN MARIN (1872-1953)

39. **Bay Bridge, Brooklyn,** 1930
Water color. John Marin, Jr., New York City

One of the greatest water colorists, if not the greatest, this country has ever produced, John Marin was born in Rutherford, N. J., and lived most of his life in Maine and the New York area. The rocky coast of the one and the skyscrapers of the other were his favorite subjects, seen and admired for their vibrant color and dynamic design in one-man shows in New York every year from 1909 to his death. His son writes, "My father used to have some relatives in the Flatbush section of Brooklyn. Occasionally, he would drive to Brooklyn; then take short trips to Coney Island and Bay Ridge. He was very much intrigued with the activity on the water at Bay Ridge; with the view of Staten Island, also at that time there were two or three old sailing vessels resting on the mud flats, with the Battery as a background."

ELY M. BEHAR (1890-1951)

40. **Winter,** 1933
Oil on canvas. Mrs. Ely M. Behar, Staten Island

The artist was born in France and came to this country at the age of ten. He taught art in New York high schools and for ten years was a successful commercial artist. He moved to Staten Island in 1933 after having made a name for himself as a painter of portraits, still lifes, and landscapes, many of which were done on his frequent trips to Normandy, Brittany, and other parts of France. Retrospective exhibitions of his work have been held by the Staten Island Museum and the Ward Eggleston Gallery.

Guy Pène du Bois (1884-)

41. **The Park,** c. 1934
Oil on canvas. Milch Art Gallery

Guy Pène du Bois, like Sloan and Marsh, has always been interested in people. He has searched for the revealing moment, and his paintings add up to a gently satiric record unsurpassed by any other painter of his day.

Perhaps it was his experience as a newspaper reporter which taught him to look sharply at people, describe them exactly, and emphasize their slightly foolish behavior and attitudes. At any rate, although the work of other painters may show superior technique, none has given so complete and accurate a description of life during the first three or four decades of this century.

Born in Brooklyn, Guy Pène du Bois was brought up in a highly literary and artistic family.[21] In 1898 they moved to Staten Island to be in the "real country," and he spent many a pleasant afternoon roaming its hills and woods. He studied art from the time he was fifteen, but from 1906 to 1924 he made his living as a journalist, first as a police reporter, then as a movie critic, and finally as art critic and contributor to many art publications.

All the while he lived on Staten Island, where he exhibited occasionally at the Staten Island Museum; but in 1924 he left for Paris, where he lived and painted for seven years before returning to this country. He did not again live on Staten Island, but he came every now and then to visit. It was after one of these visits, on a Sunday, that he did our painting, "The Park." Although done in Manhattan, it was inspired, according to the artist, by the memory of an outing in Clove Lakes Park. Typical of the artist's most mature and discerning style, the painting is unusually warm in its observation of the human comedy.

Horace Talmadge Day (1909-)

42. **Speakeasy — Staten Island,** c. 1936
Water color. Mrs. Donald Day, Westfield, N. J.

From 1930 to 1940 the artist's father, the Rev. Steward Day, lived on Staten Island as a minister of the Dutch Reformed Church. Horace Day came often to visit his family and enjoyed painting the old buildings along the Kill Van Kull, exhibiting his work occasionally at the Staten Island Museum. He is now a teacher of art at Mary Baldwin College, Staunton, Va., and has had one-man shows at the Memphis Academy of Art, the Gibbes Museum of Charleston, and the Virginia Museum in Richmond.

[21] For a full and delightful account of the artist's life see his *Artists Say the Silliest Things,* New York, 1940; and for a brief review see Gerald Bernstein's introduction to the catalogue of the retrospective exhibition of the paintings of Guy Pène du Bois from November 14 to December 14, 1954, in the Staten Island Museum.

VICTOR JOSEPH GATTO (1890-)

43. **John L. Sullivan's Beer Party at South Beach,** c. 1939
Oil on canvas. Charles Barzansky Gallery

One of the most unusual and colorful men in art today, Mr. Gatto has been a professional fighter and a steamfitter. He took up painting in 1937 when he was shocked to learn that a painting at the open-air show in Greenwich Village was priced at $600. Convinced that he could "do better than that," he bought dime-store brushes and house paint and set to work with the vigor of ten men. A year later, aged 48, he showed his own paintings for the first time. His first one-man show took place, at the Barzansky Gallery, in 1943. Considered by some as a logical successor to the modern primitive, Rousseau, his works have been acquired by such collectors as Mrs. Somerset Maugham, Huntington Hartford, Rosalind Russell, and Mrs. James Warburg.[22] Mr. Gatto saw the party at South Beach when he was taken there on an outing as a small boy. He did the painting from memory after making a trip to South Beach to check.

GILMER PETROFF (1913-)

44. **House on the Beach at Great Kills,** 1939
Water color. Miss Dorothy Smith

A resident of Staten Island from 1936 to 1943, Mr. Petroff exhibited at the Staten Island Museum, ran his own school of water color painting, and has won many awards, especially in the South, in the last ten years. Since 1946 he has made his home in South Carolina. Of special interest to Staten Island is the fact that he painted the murals in the Colonial Building and Loan Association.

LUIS QUINTANILLA (1895-)

45. **Staten Island,** 1939
Oil on canvas. Mrs. Karl Zimmer, Indianapolis, Indiana

Born and trained in Spain, Mr. Quintanilla now has paintings in the best museums of Madrid, Barcelona, and Paris, as well as the Museum of Modern Art, the Metropolitan Museum of Art, and the Art Institute of Chicago. He has done many portraits, especially of famous literary figures, and he has illustrated many fine books and frequently does drawings for *New Yorker,* one of which was a portrait of George H. Hunter, Staten Island resident of Sandy Ground, in the recent "Profile" article, "Mr. Hunter's Grave," by Joseph Mitchell.[23]

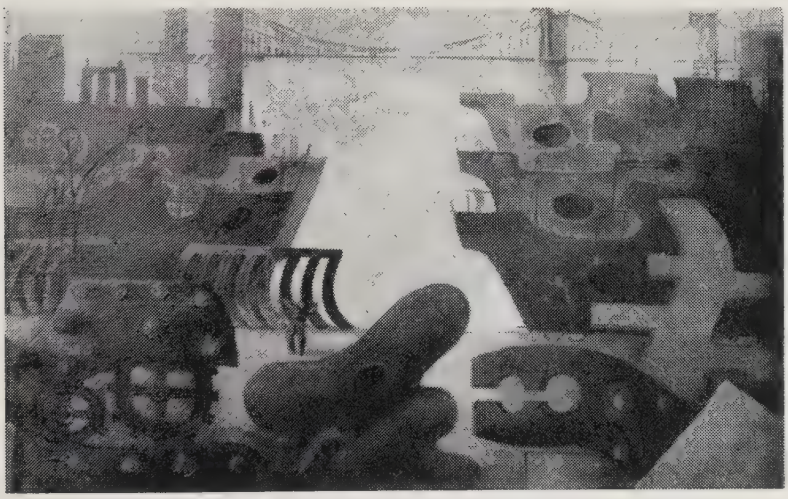
[22] Harry Salpeter, "Gatto: Little Primitive," *Esquire,* May, 1946.
[23] *New Yorker,* September 22, 1956, pp. 50-95.

It is interesting to note that his fanciful painting of Staten Island was one of the first paintings done after he came to this country in 1939. Its stylized pattern is reminiscent of the many murals he did in his native country.

CECIL CROSBY BELL (1906-)

46. **Winter Trip,** c. 1944
Oil on canvas. Lent by the artist

Born in Seattle and trained in Chicago and New York, Mr. Bell moved to Staten Island in 1942 from Greenwich Village because he liked the ferry ride and the view from the Staten Island hills, on one of which he lives. He has exhibited at the Corcoran Gallery of Art, Pennsylvania Academy of Fine Arts, the Whitney Museum, the Art Institute of Chicago, and for a number of years with the Staten Island Museum. He has had several one-man shows at the University of Nebraska and the Kraushaar Gallery of New York. His paintings are in the permanent collections of the Whitney Museum of American Art, Howard University, Cooper Union, and the Childe Hassam Fund.



Julio de Diego, "They Will Cross the Seven Seas"
Courtesy of the artist (No. 47)

JULIO DE DIEGO (1900-)

47. **They Will Cross the Seven Seas,** 1944
Oil on canvas. Lent by the artist

Winner of many prizes and awards, Mr. de Diego is one of our most honored painters. His work hangs in most of the major museums of this country, and he has exhibited in far too many important European and American institutions to mention here. He was born and trained in Spain, but he has become famous in this

country as a designer, craftsman, illustrator, and teacher, as well as a painter. The painting shown is one of several done at the St. George Coast Guard Station, one of which in 1954 won the $2000 purchase prize of the Birmingham Museum of Art.

REGINALD MARSH (1898-1954)

48. **Lower Deck,** 1945
Chinese ink and water color drawing. Mrs. Reginald Marsh, New York City

Mr. Marsh lived in or near New York City all his life after he moved there in 1920. Like Sloan, he found this great city to be his favorite subject. He began painting seriously in 1923, and in the years between 1929 and 1940 he poured out the series of egg tempera paintings and water colors which made him famous. He loved people and went wherever they congregated. Drawings made at Coney Island and other such places, with his swift sure stroke, have in recent years become as well known to the public as his paintings. The example shown here is typical.

LOUIS R. FINK (1925-)

49. **The Water Carnival,** 1954
Oil on canvas. Lent by the artist

One of the most promising young artists on Staten Island today, Mr. Fink has already built up quite a reputation. His work has been chosen for such exhibitions as the tenth annual exhibition of Audubon Artists in 1952, the international drawing show held by the Chicago Art Institute in the same year, the 149th annual exhibition of the Pennsylvania Academy of Fine Arts in 1954, and for the exhibition, "Recent Drawings, USA," held by the Museum of Modern Art in 1956. His drawing, "The Widow," was chosen from this show for reproduction in *Art News.*

The painting on display was done after the artist had spent a day on the beach near the Tottenville Yacht Club watching the carnival activities.

EINAR LUNDEN (1923-)

50. **Sunset,** 1954
Water color. Contemporary Arts Gallery

This young Staten Islander, whose sense of design and color are outstanding, has already made a name for himself. He has exhibited at the Butler Art Institute and the Des Moines Art Center; and one of his paintings has been acquired by the Rochester Memorial Art Gallery. He has been accepted three times for the International Water Color Exhibition at the Brooklyn Museum, in 1949, 1953,

and 1955. Beginning in 1954, one of his water colors toured Europe as part of the special exhibition, "Contemporary Water Colors of the United States," assembled at the invitation of the American Embassy in Paris. Like so many of his other paintings, "Sunset" was done at a spot close to his home in Port Richmond.

PERCY ALEXANDER LEASON (1889-)

51. **February Snow,** 1955
Water Color. Mr. Edward L. Love, Staten Island

Well known for his oil paintings, Mr. Leason is also an excellent water colorist, of which "February Snow" is one of the best examples. Among many other places, he has exhibited at the National Academy of Design and with Audubon Artists, Inc., where he won a prize in 1945. He is a successful portrait painter, illustrator, and teacher of art on Staten Island and, as the president of the Section of Art of the Staten Island Museum for a number of years, did more than anyone else, perhaps, to make that organization the enthusiastic and active group it is.

FRIEDA MULCAHY (1918-)

52. **Boats in the Kill Van Kull,** 1956
Oil on canvas. Lent by the artist

This young Staten Island painter, with her strong sense of color, design, and texture, gives promise of a very bright future indeed. Having studied mostly with Sol Wilson, she has exhibited her work at the Pietrantonio and Morris Galleries, in the open national exhibitions held by the City Center Gallery and the ACA Gallery (where she received an Honorable Mention), and at the annual spring exhibition of the Staten Island Museum, where she won First Prize in 1956.

This exhibition was planned, not only to mark the Institute's 75th anniversary, but also to emphasize the Institute's policy of building up a regional collection of paintings, prints, and drawings. Staten Island works of art turn up rather frequently, but, unhappily, we usually do not have the means to acquire them. At least one person is helping us regularly with this problem, but one person cannot do it alone. We need more friends who will do one or more of four things: (1) contribute to an art purchase fund, (2) purchase and present appropriate works of art to the Institute, (3) donate works of art from their own collections, and (4) call our attention to those which are available.

Pen and ink drawing of the old Crocheron mill by Richard Winant, son of Freeman Winant. The mill stood o Signs Road on Winant property in what was then known as Chelsea Heights (see map).

A HISTORY OF THE WILLIAM T. DAVIS WILDLIFE REFUGE

By

GORDON LOERY

This is the first of several articles on the Refuge to appear in this publication during the Institute's 75th anniversary season, 1956-1957.

UP UNTIL the seventeenth century, the urban world and the world of nature were treated as separate and distinct entities—partly for architectural and aesthetic reasons and partly because cities were smaller and the countryside was more accessible to all. Nature was represented in the earlier European city only in the form of private gardens which were not an integral part of the city itself.[1] With the advent of the sprawling industrial and commercial cities of the nineteenth century, public "green lungs" became almost a necessity.

[1] Tunnard, Christopher, "The Leaf and the Stone," *Art Magazine*, February, 1951.

Burial grounds such as Boston's famed Mt. Auburn Cemetery, offering their services to the quick as well as the dead, were among the first solutions to this problem; and of course bird watchers still find them very useful, particularly during the migration season. "Multiple-purpose use" is a relatively new term for an old custom. Today, however, cemeteries and parks are not enough. Now that cities are becoming even more decentralized and so much of our land is taking on at least some of the characteristics of an urban area there is a growing need to preserve wilder and more natural areas in suburbs, if not in the center of cities.

Staten Island is usually thought of as New York City's sylvan borough. But unfortunately Staten Island's landscape is no longer as well-wooded as it might be. For one thing, the Island's population has been rising rapidly in recent years and people must have homes in which to live. However, that is not the whole explanation of what has happened. Too much of the destruction of natural beauty has been unnecessary. There was, for example, a good deal of premature clearing and subdivision in the speculative years of the 1920's; and a good many fine old trees were cut for fuel during the depression years of the 1930's. Today, roadside dumping is common along undeveloped streets; the prevailing winds carry with them fumes from New Jersey's factories, and according to the Fire Department over two thousand brush fires are reported on the Island every year. The consequent deterioration in the quality of the open spaces has not attracted much attention because it has been a slow process. But it has been extensive. Back in the 1890's Mrs. Elizabeth Britton found and identified over one hundred different species of mosses on the Island. Today, Lee Ellison cannot find more than twenty-five species. Of course this decline in the number of moss species is not in itself of earth-shaking importance. But it is a dramatic indication of change. Many of the fields and woods are still there, but they are not what they used to be.

Some of the adverse conditions on Staten Island are beyond the control of man. For example, the frequent lack of a snow cover, which makes it more difficult for plants to survive during the winter, belongs in this category. Others, such as air pollution which is an interstate problem, cannot be solved by Staten Islanders alone. But there is much that the people on the Island can do, and they have already made a start in the right direction. The William T. Davis Wildlife Refuge is the most impressive evidence of

their efforts. Perhaps those who use the refuge in the future will gain a little better understanding of it from reading this brief review of its history.

EARLY HISTORY •

The early history of what is now the William T. Davis Wildlife Refuge can be roughly subdivided into three periods: first, a period of individual private ownership (before 1880); second, a period during which ownership by private water companies was predominant (1880-1910); and finally, a period in which municipal ownership was predominant (1910 on).

General farming was the principal form of land-use during the first of these historical periods. The farmers of the time raised a variety of crops, such as corn, potatoes, wheat, and tomatoes. They also cut salt hay, most of which they used for packing. Unlike the few remaining farmers in this area, who concentrate on raising truck farm products, they were not agricultural specialists.[2]

Most of the farm land was subdivided into strips which ran roughly parallel to South Broadway (Richmond Avenue) and Richmond Turnpike (Victory Boulevard). The early houses were usually built on Signs Road with the land accompanying each house extending beyond Travis Avenue (originally New Springville Avenue and later Union Avenue). On a map of Staten Island dated 1853, New Springville Avenue extends only part of the way in from Richmond Avenue. Later it cut across the old farm strips.[3]

On a map of 1874 the principal land owners (moving from west to east) were listed as T. Rosevelt, J. Winant, F. Winant, and I. Vreeland. North of Travis Avenue, the boundary line between the land of F. Winant and I. Vreeland appears to be approximately the same as the present refuge boundary. All of these land owners were farmers, with the possible exception of "T. Rosevelt" (which should have been spelled "Roosevelt"). Theodore Roosevelt's grandfather and father owned this piece of land and had a house on Signs Road. The Roosevelt family used the area as a country home, but finally abandoned it "because everybody who went there

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[2] Based on a conversation with Richard Winant whose father, Freeman Winant, was one of the old landowners in New Springville.

[3] Maps of Staten Island dated 1853, 1874, 1898, 1907, and 1917 were consulted in the library of the Institute at 146 Stuyvesant Place.

got chills and fever."[4] The chills and fever were quite likely the result of malaria. In any case, the Roosevelts sold the land after the death of Theodore Roosevelt's father in 1878. This "claim to fame"[5] is of special interest for this study since it not only indicates an exception to the general rule of early farming in this area, but also establishes at least a tenuous connection between the wildlife refuge and one of the early spokesmen for conservation at the national level.

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4 Leng, Charles W., and Davis, William T., *Staten Island and Its People,* Lewis Historical Publishing Co., Inc., New York, 1930; Vol. II, p. 945.

5 Hampton, Vernon, *Staten Island's Claim to Fame,* Richmond Borough Publishing and Printing Co., Staten Island, N. Y., 1925; pp. 155-158.

A number of small industries developed as a by-product of the early farming in this New Springville area. There was, for example, a dock built on the Richmond Turnpike side of Main Creek near Union Avenue. Street sweepings were brought in from New York City by barge and unloaded at this dock to provide a source of manure for the neighboring farms. Then, there was the Crocheron saw and grist mill which was located on Main Creek on the far side of Signs Road just outside the present refuge boundaries. Finally, the Myers and Gilbert Preserving House appears on the 1874 map in the general vicinity of the present Park Department storehouse near the Travis Avenue entrance to the refuge. The preserving house was a tomato canning plant which helped process the local tomato crop.

The Staten Island Water Supply Company, incorporated in 1879, helped begin a new era in New Springville when it acquired the old Vreeland property south of Union (Travis) Avenue and built a pumping station at the present location of the Park Department storehouse. At about the same time the Crystal Water Company, another supplier of Staten Island water, bought the Roosevelt and Freeman Winant land. The latter dammed up a reservoir just south of Union Avenue on the old Roosevelt property and sank some artesian wells which can still be seen near the trails in the refuge. However, the private water companies did not last very long.

By 1907, according to a map of that date, the New York City Department of Water Supply had acquired the land of the Crystal Water Company and, on February 17, 1909, the land of the Staten Island Water Supply Company was deeded to the city water department. The era of municipal ownership had begun. The only land remaining in private ownership was the open central strip on the north side of Travis Avenue which had belonged to J. Winant and had never been acquired by either of the water companies. Farming operations continued on this central strip long after they had been abandoned on the neighboring land.

The city continued to operate the New Springville waterworks for a few years until Staten Island began to receive Catskill water and no longer needed this local supply. After that the city retained ownership of the land and eventually transferred it to the Park Department. The privately owned strip remained in the hands of the Wentz and Heilbrunn families until the 1940's, but it too was finally taken over by the city.

The period of city ownership set the stage for the wildlife refuge movement, but before going on to that, one final phase of municipal activity in the New Springville area should be mentioned, since it has had an important effect on the Staten Island landscape. Some time around 1910 the city began digging drainage ditches in the salt marshes and spreading oil over them in the hope of reducing the mosquito population. One witness to these operations has reported that the oil spreading was not carried out very efficiently. Apparently, the workers took it easy on warm days and simply dumped most of the oil wherever they happened to be when quitting time arrived. However, the oil was disposed of in the marshes in one way or another.[6]

THE WILDLIFE REFUGE •

On November 17, 1928, William T. Davis wrote to T. Gilbert Pearson, the president of the Audubon Society, suggesting that they "secure the control of a portion of the extensive park woodland on Staten Island and there establish a bird reservation and protected natural area."[7] This is the first written evidence we have of a concrete proposal being made for establishing a wildlife sanctuary on Staten Island. Nothing much came of this initial proposal until 1932, when Mr. Davis renewed his correspondence with the Audubon Society, citing over 2,000 acres of Park Department land on the Island, part of which might become another Bronx Park. He went on to say that if the Park Commissioner would set aside some land as a sanctuary, he and other interested Islanders, with the help of the Audubon Society, could build a cat and rat proof fence around it, plant trees and shrubs attractive to birds in it, set up bird feeding stations and nesting boxes, and label items of particular interest. As a starter, Mr. Davis offered to contribute $1,000 towards the building of a fence.[8] Ernest G. Holt, the Director of Sanctuaries for the Audubon Society, replied that all the money for a fence would have to come from Staten Island and $1,000 might not be enough.

The Audubon Society's inability to make a financial contribution to the refuge did not discourage the small group of interested Staten Islanders. A committee, including Davis, Holt, James P.

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6 Conversation with Richard Winant.

7 Letter from William T. Davis to T. Gilbert Pearson, November 17, 1928.

8 Letter from William T. Davis to Ernest G. Holt, December 14, 1932.

Chapin, and Carol Stryker, soon began inspecting likely refuge sites. They gave particular attention to Park Department land in the New Springville area, in Wolfe's Pond Park, and in LaTourette Park. By the end of January, 1933, they had tentatively agreed that the New Springville location was the best of the three.[9] Later that year Holt wrote Davis to tell him that the Staten Island Park Commissioner, John J. O'Rourke, had agreed to set aside 51 acres of land in the New Springville Park as a bird sanctuary.[10] The 51 acres included the old Vreeland property south of Travis Avenue, which had been acquired by the Staten Island Water Supply Company. It is the wooded area through which the present nature trail runs.

The original plans called for a fence around the whole area, with a gate opening to the public and a second fence around a central area with a locked gate. The inner gate, a symbol of this attempt to curb public access in the name of natural preservation, is still standing but is now permanently open. It is located on the trail which leads into the present bird feeding areas. Many of the cedar posts, imported from Amenia, New York, which were used for the fencing, are also still standing.

In a letter of February 2, 1934, Mr. Davis described the flora of the refuge in some detail.[11] This letter cannot be reproduced here, but it is of some importance, since it is a starting point for all future studies of changes in the area. His description of the prevailing trees, in which he listed the elm as predominant with sweet gum second in importance, is of particular importance today. In the middle of 1933, shortly after the refuge site had been chosen, the Dutch elm disease made its first appearance on Staten Island. The results of this introduced disease are all too evident in the refuge today.

In June, 1934, Robert Moses, the newly elected Commissioner of a consolidated five-borough Park Department, stated, "We are keeping the Bird Sanctuary for the present. We cannot say at this time whether it can be a permanent part of the park development." He seemed sympathetic to the idea, but there was evidence of dissatisfaction in other quarters. The Audubon Society, distressed because of the general run-down condition of the refuge, which it attributed to vandalism, lack of maintenance, and the failure of the

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[9] Articles in *Staten Island Advance,* January 14, 1933, and February 18, 1933.

[10] Letter from Ernest G. Holt to William T. Davis, August 24, 1933.

[11] Letter from William T. Davis to Robert P. Allen, February 2, 1934.

Park Department to hold to its promises, felt inclined to withdraw from the project. The Audubon Society wanted not only better maintenance but an enlargement of the refuge to 100 acres with a small pond created in the marsh area.[12] The refuge has now been enlarged to 260 acres and the plans for the future call for an impoundment on Main Creek, but at the time there was not enough interest on Staten Island to justify the carrying out of these recommendations. A few individuals kept up the bird feeding stations, but there was a continuing decline in both the appearance and usefulness of the refuge for a number of years.

Finally in 1952 the project was revived. The Section of Natural History of the Staten Island Institute of Arts and Sciences, under the leadership of the Institute's Director, Dr. James L. Whitehead, injected some new life into it, especially during and after an all-day conference on conservation in urban communities, held at the Museum on May 16, 1952. A committee then drew up plans for the enlargement of the old refuge, the laying out of new trails, a program of nature education, and a campaign to win the cooperation and approval of the Park Department. After a series of conferences between the Park Department officials and Dr. Whitehead the committee's plans were accepted in the fall of 1954 by the Park Department and a plan of procedure was worked out.

According to the new plans, the refuge will eventually include 260 acres—the original 51, plus the additional land on both sides of Travis Avenue that the city had acquired from the Crystal Water Company and the Heilbrunn estate. At present some of this property is still under the control of the Department of Sanitation. The emphasis has been placed on developing its educational values. In line with this policy, the refuge committee and the Staten Island Borough Department of Parks laid out a short nature trail to be used in a program for guiding small classes of school children through the refuge. Twelve volunteer leaders, under the chairmanship of Miss Mathilde Weingartner, guided over two thousand children through the refuge during the first year of operation under this program, which began on May 16, 1955 (exactly two years after the conservation conference), and even this was not enough to satisfy the demand from the schools for this service, since hundreds had to be placed on a "waiting list."

[12] Letter from Robert P. Allen to William T. Davis, January 21, 1935.

To some extent wildlife protection and outdoor education on such a large scale are incompatible. The students may frighten away or destroy the very things they are being taught to respect. But there are also advantages to be gained from combining the two objectives in a city park area. First of all, the advantages of nature education to city children in a really natural area, are incalculable.* Secondly, children may be somewhat less inclined to set fire to neighboring fields and woods after being introduced to the plants and animals in a refuge. If so, open spaces all over the Island will benefit. And perhaps equally important, an effective, efficiency-minded Park Commissioner will be impressed, it is to be hoped, by a program serving several thousand school children every year, even if he has no particular interest in wildlife protection for its own sake. The chances for maintaining the city-owned William T. Davis Wildlife Refuge as a refuge seem to be much greater today than they were before the new educational program began. As a general rule, wildlife conservationists are much more likely to succeed if they ally themselves with another cause when working in an urban area, even if such an alliance brings with it new problems and necessary compromises.

BOOK REVIEWS

THE WORLD OF NIGHT, by Lorus J. and Margery J. Milne. Harper & Brothers, New York. 1956. $3.75.

Here is a book that this reviewer sank his teeth into with pleasure and profit above average for the reason that he has devoted much of the past twenty years to recording on motion picture film the behavior and activities of nocturnal animals.

The man-and-wife team of Lorus and Margery Milne—he, Ph.D. Harvard; she, Ph.D. Radcliffe—has produced a highly readable 239-page book, enhanced by superb and imaginative pen-and-ink drawings done by Canadian artist T. M. Shortt. In the book's fifteen chapters the Milnes manage to present a surprisingly comprehensive summary of what night is like, and what night means to living things, from the solar regions to the tropics. The diversity of subject matter is indicated by a few chapter headings selected at random: Echoes of the Night, Dark Waterways, Jungles under Moonlight, Polar Darkness, The Desert Night.

* An article by Dr. Whitehead on the education program will appear in the spring issue of this publication for 1957.

Because the Milnes are credited with having traveled in excess of 250,000 miles in Canada, the United States, Mexico, and the American tropics; and because of their background of scientific training and scholarship, the statements and observations to be found in this book can be accepted as accurate and authentic, although some of them might well be dismissed by the skeptic as fiction. In addition to their own first-hand accounts of observations and experiences in many latitudes and environments, the authors pass on to the reader selected gleanings from W. H. Hudson, Thoreau, Aldo Leopold, Alexander von Humboldt, and others.

Whoever reads *The World of Night* will surely feel the urge to equip himself with a good jacklight and start exploring after dark along fresh water shores, on the sea beach, in the woodlands and marshes, or in his own back yard.

HOWARD CLEAVES

TRAVELS AND TRADITIONS OF WATERFOWL, by H. Albert Hochbaum. The University of Minnesota Press, Minneapolis. 1955. $5.00.

H. Albert Hochbaum's second book, *Travels and Traditions of Waterfowl,* is aimed at the broader topic of bird migration, but the title itself is quite accurate. A major part of the subject matter is concerned with the local and migrational movements of the ducks, geese, and swans of the great Delta marshes in Manitoba, and with the introduction of the new concept of tradition as a factor in bird migration. This work is one of the concrete results of activities at the Delta Waterfowl Research Station, which is sponsored by the North American Wildlife Foundation and the Wildlife Management Institute.

In an easily readable style this writer develops his theory with precision, supporting his points with references to the published findings of others, or with experiences encountered during his years as director of the Delta Waterfowl Station. There is no tendency to over-simplification of a complex subject, and the contrary facts and references are cited as well as the supporting ones. In brief, it is shown that in waterfowl, paths of migration must be learned from experience and that they are traditionally followed in succeeding years.

The tendency to consider migrational journeys and the associated navigation problems in the light of human experience is well described. Distance and orientation are shown to be relatively simple for a duck flying 60 miles per hour at 2,000 feet elevation as compared with a man walking 4 miles an hour with his eye level 5½ feet above the ground. The explanation is technically correct, yet lucid enough to be readily understood.

The book is illustrated with a number of interesting sketches by the author, indicative of his understanding of waterfowl and his appreciation of the Delta marsh country. A particularly amusing sketch on page 32 shows three whistling swans alertly watching what seems to be a tiger swallowtail butterfly fluttering directly over their heads.

Important new thinking that should interest anyone concerned with ornithology has been set forth in this book. If you are just an ordinary garden variety "bird-watcher" like the reviewer, don't be afraid of this volume; it is good reading.

JOHN A. LE MAIRE

SPIDER, EGG, AND MICROCOSM, by Eugene Kinkead. Alfred A. Knopf, New York. 1955. 244 pages. $4.00.

With great skill and enthusiasm Mr. Kinkead guides us through the wonders of nature into the lives of three eminent specialists in the fields of science, so that we may partake of the great store of knowledge accumulated by them through lifelong study and research with phenomena of nature.

With Dr. Alexander Petrunkevitch, retired Yale University Professor of Zoology and Dean of American Arachnologists, we observe and study the spider, one of man's best and yet most slandered and persecuted friends —engineer extraordinary and of royal blue blood* when we consider ancient lineage that dates back to the Devonian Period, roughly 300 million years ago. Discovery by Dr. Petrunkevitch of the development of reproduction in spiders that have sperm-producing and sperm-transmitting organs unconnected and in different parts of body could be considered the apex of his career.

Through the eyes of Dr. Alexis Romanoff, Professor of Chemical Embryology at Cornell University and foremost American embryologist, we gaze upon the avian egg and penetrate its calcereous enclosure to behold the germ cell, fountain of life, surrounded by a circle of protoplasm containing germinal elements which are activated through fertilization. In Dr. Romanoff's own words, the avian egg is "the biologically perfect entity, the product of a remarkable physiological factory, and an architectural marvel."

Dr. Roman Vishniac, outstanding scientific photographer of microscopic organisms—with doctorates in Zoology, Medicine and Oriental Art —relies on modern optics and color film to present to us the colorful panorama of a living microscopical world. His specialty is the study and photography of unicellular animals called protozoa of which approximately 15,000 species are known and which have lived on this earth for about 2 billion years. Inasmuch as only relatively few people have seen his pictures on the screen or in print, their lack in this fine book is regrettable.

HUBERT J. THELEN

ALL ABOUT SNAKES, by Bessie M. Hecht. Random House, New York. 1956. 143 pages. $1.95.

THE BOOK OF REPTILES AND AMPHIBIANS, by Michael H. Bevans. Garden City Books. 1956. $2.50.

The writing techniques employed by Bessie M. Hecht in explaining the wealth of information she presents in this book about reptiles holds the reader's interest to the last word on the last page. Here is a book which, despite a few minor errors, captures in print the fascination that these animals hold for people. Do snake charmers charm snakes? Do snakes eat snakes? Are there sea serpents? What snakes are most poisonous? Do snakes have legs? How many eggs does a snake lay? How big do snakes

* The spider has pale blue blood.

grow? Can snakes sting with their tails? How do you milk snakes? Can you tell the age of a rattlesnake? The interesting and informative answers are all there, to these and many other questions.

The intelligent and timely slanting of *All About Snakes* to an age level ranging from nine years to the teens makes it an excellent companion to *The Book of Reptiles and Amphibians* of which Michael H. Bevans is both author and illustrator.

The text of *The Book of Reptiles and Amphibians* is direct, inclusive, and informative, and is aimed at an interest level of teen-age to adult. However, it is in the illustrations rather than in the text that we find the great value of this book. Much of the written material can be found in other treatises on snakes, but nowhere else can such excellent reptile and amphibian paintings be found. The artist's opportunity to place the subject in the position most advantageous to show important characters, added to Mr. Bevans' ability to accurately portray these animals, makes this book, in my estimation, a must in all herpetologists' libraries.

ROBERT F. MATHEWSON

THE COMMUNITY OF LIVING THINGS, edited by Etta Schneider Ress. Creative Educational Society, Inc., Mankato, Minnesota. 1956. $35.00. In five volumes: Vol. 1, *Field and Meadow;* Vol. 2, *Fresh and Salt Water;* Vol. 3, *Parks and Gardens;* Vol. 4, *Forest and Woodland,* and Vol. 5, *The Desert.*

This handsome five-volume set of books is a fine introductory voyage around the world of nature. The magnificent full-page pictures merit long study. The brief text accompanying each photograph should appeal to those who do not like to find themselves adrift in a sea of scientific terms. The many interesting facts given perhaps may stimulate the cruising reader to travel further in the fascinating land of research. Such a reader will wish that the scientific, as well as the popular, name of each subject had been given in all the volumes. Such unmistakable identifications appear only in the volume on deserts, and, therefore, this fifth volume seems by far the most valuable.

OLIVE L. EARLE

ANIMALS IN FUR, by Clarence J. Hylander. The Macmillan Company, New York. 1956. 206 pages. $3.50.

This is the fourth of Hylander's books in the Young Naturalist Series. It is an introduction to mammals and follows *Animals in Armor,* which is a beginner's book on reptiles. Intended for the youthful reader, this book seems to be suitable as a gift for the interested child. At the same time, however, the adult reader is almost sure to broaden his own knowledge of mammalogy. For this is not a picture book or a field manual, but has a text which only older children could be expected to read. Although illustrated with a modicum of line drawings and black and white photographs, representative mammals of each order and family are shown, plus a few plates on tracks, burrows, etc. This book is not intended as a manual for identification of mammals as much as it is a readable book on mammals and their natural history.

Five principal chapters cover the major orders of mammals; viz.: the gnawing mammals, the hoofed mammals, the carnivora, the sea-going mammals, etc. For the seriously interested reader an index provides Latin names of the families and the most common species of mammals in the United States. The author's plan is to provide brief "biographies" of the most familiar and important mammals. The opening chapter tells us what a mammal is in terms of its structure, biology, and habits. The concluding chapter is a concise unit on natural history which deals with the variety of homes made by different mammals and the interesting modifications in family life resulting from raising young in trees, in burrows, and in the depths of oceans. Some interesting facts on hibernation are also brought out. The author has thus presented the lay public with a good introduction to systematic mammalogy and a very brief look at the natural history of mammals.

CARLITA NESSLINGER GEORGIA

CRICKETS, by Olive L. Earle.* Illustrated by the author. William Morrow & Company, New York. 1956. $2.00.

Miss Earle uses imagination in the selection of details. She writes in a lively style, but with an economic use of words. The result is a book which, though small, is remarkably informative. There is accurate information on the life cycle of the field cricket, where it lives, what it eats. There is an excellent description of the mechanism by means of which the cricket produces its characteristic chirp. In addition to the field cricket, other varieties, including the snowy cricket and the mole cricket, are described, at least briefly. Miss Earle tells us that "crickets are usually silent when the temperature falls below 55 degrees Fahrenheit. When they are making their music they vary its regularity and pitch according to the weather." The snowy cricket is especially sensitive to the weather, and there is even a formula for determining the temperature by counting the number of chirps in a given time. The vagaries of our weather should add interest to the experiment!

Interest in the cricket is more than seasonal, however; nor is this interest confined to those with a scientific turn of mind. The cricket has had a long history as a pet, and the book gives some practical suggestions for the care of a pet cricket. The author can only suggest the cricket's place in folk lore and legend and leave further exploration to the reader. Like all of Miss Earle's books for young children, this may serve as a springboard to an appreciation of the naturalists whose writings have become literary classics; for example, Jean Henri Fabre.

One could wish for a larger page to allow more scope for Miss Earle's fine drawings. The price, however, insures the book a place on book shelves from which a higher price might exclude it.

KATHRINE DRISCOLL

* Staten Island resident.

POST-IMPRESSIONISM, FROM VAN GOGH TO GAUGUIN, by John Rewald. The Museum of Modern Art, New York. 1956. 600 pages, 520 plates. Distributed by Simon and Schuster. $15.00.

Until comparatively recently, serious art scholarship devoted to the origins and development of twentieth century movements in art has been buried under eulogy, psychological analysis, and the more picturesque aspects of artists' lives. With the publication of *Post-Impressionism, from Van Gogh to Gauguin,* by John Rewald, the crucial years 1886-1893 are given substance in a true historical sense.

Vincent Van Gogh and Paul Gauguin are the central figures of this study, and the body of their work represents culminating points in the bewildering complexity of ideas both visual and literary which ushered in a new era of history. The book begins with Van Gogh's coming to Paris as an art student in 1886. This year saw the breakup of the impressionists as a group, and the emergence of the symbolist poets as opposed to the naturalist school of writing led by Emile Zola. The symbolists, weary of the bleak prose of the naturalists, advocated a new synthesis of language and idea, in which the words used by the writer most completely conveyed in feeling and context the idea expressed.

The synthesis of music, action, and plot in the music of Wagner was greatly admired by the symbolists. The paintings of Puvis de Chavannes seemed to embody the symbolist ideals of "noble ambition, and a new art of delicate harmonies." The poets Baudelaire and Verlaine were conducting personal investigations into physical and mental sensations, rediscovering, as it were, a new language for the expression of human experience.

The theories of light and color formed by the impressionists found their culmination in the scientific investigation of color and form in the work of Georges Seurat and Paul Signac.

The most fascinating and rewarding aspects of the book are the exhaustive accounts of the lives, influences, and friends of both Van Gogh and Gauguin during this brief span of years. Gauguin went to Brittany where he found a "primitive and wild" way of life; Van Gogh to Arles for what he called "the equivalent of Japan." The appeal of Japanese prints and their exquisite sense of color and design had a great influence on the art of both Van Gogh and Gauguin.

The painter Emile Bernard emerges here as one of the major influences in the lives of both Van Gogh and Gauguin. Although his early work with Gauguin showed great promise, he could not sustain his vision and lapsed into banality.

After the death of Van Gogh in 1890, Gauguin redoubled his efforts to go to the South Seas. Van Gogh had found his "Japan" in the south of France, but Gauguin still yearned for his "primitive way of life." After the sale of his pictures in 1891, Gauguin set sail for Tahiti, where he spent two years realizing his potentialities as an artist.

The central theme of the book is the struggle of the artist to abstract from nature the essential elements with which he creates a unique and personal view of reality.

RICHARD A. DAVIS

GEORGE WILLIAM CURTIS AND THE GENTEEL TRADITION, by Gordon Milne. Indiana University Press, Bloomington, Indiana. 1956. $6.00.

Here is a biography which fills a real gap in the history of American literature and politics. George William Curtis was a powerful influence on these and other aspects of American life during the latter half of the nineteenth century. During the first half of the twentieth his very name has been almost forgotten, and the only biography to which students of the period could turn has been the pitifully inadequate one by Cary, published in 1894.

Mr. Milne has done a fine piece of research. The book is clear and orderly, loaded with detail and thoroughly documented. If we may feel that the "Literary Estimate" which follows the narrative is more extended and serious than the permanent value of Curtis's contribution to American letters justifies, on the other hand, the "Postscript" which defines the Genteel Tradition enables us to realize how complete a turning-point was his choice to enter the decidedly un-genteel political struggle of that period. He was born into the old tradition. He could no more escape it personally than he could escape the color of his eyes; but in his career he deliberately broke with it when he chose, instead of remaining a successful author of florid, charming, thoughtful and sentimental novels, travel books and essays, to place his abilities at the service of what he felt to be his duty as a citizen. (In the opinion of this reviewer, the choice made him a much better writer, though a very different one.) In one form or another, many men and women have had and always will have to choose between the old and the new, and it may well be that the story of Curtis's decision and its outcome will mean as much to readers today as his courageous and persistent fight to reform the Civil Service of his country.

He lived on Staten Island for thirty-six years, and took an active part in its social and political life. A very few Islanders can still remember him in his latter days; many remember his wife and his daughter Elizabeth; their simple, dignified home still stands here; and the Curtis Collection of this Institute is one of the sources from which Mr. Milne has drawn his excellent piece of work.

MABEL ABBOTT

THE TREMBLING HILLS, by Phyllis Whitney.* Appleton-Century-Crofts, Inc., New York. 1955. $3.75.

In September, 1956, Phyllis Whitney, whom we think of as "belonging to us," added a new novel for adults to her already impressive list of published works. *The Trembling Hills* is the kind of book I could not put down until I had reached the very end. It has the tempo and climactic suspense of a mystery, but it has more than that; it is a bit of Americana. Although the characters are fictional, they relive the great catastrophe of the San Francisco fire of fifty years ago, revealing the kind of courage that rebuilt the city and personal careers upon its ashes. Obviously Miss Whitney has done a considerable amount of research.

* Staten Island resident.

The story revolves around Sara Bishop, who has just moved to the wealthy, exclusive Nob Hill home of the Renwick's, where her mother has taken a position as manager of the household. Here, Sara is thrown into daily contact with Ritchie Temple, whom she had always expected to marry; with Judith Renwick, his fiancée; Nick Renwick, her brother, and Geneva Farady, who loves Nick. Sara attempts to unravel the mystery of her own past and to overcome difficult personal problems. In Aunt Hester Farady, the dramatic flavor of the Spanish strain in old California is effectively drawn, suggesting, also, that almost extinct type, the Victorian dowager — dictatorial, ruthless, courageous, and colorful. Miss Whitney, with her usual recognition of minority groups, has epitomized in the person of the silent Ah Foong the qualities of the Chinese servant—devotion, thrift, ingenuity, and affection. The metamorphosis of Allison Renwick, under Sara's influence, reveals Miss Whitney's insight into the mentality of the pre-adolescent girl.

On the whole, the characters are three-dimensional. If Miss Whitney appears to have "thrown the book at us" by using every device—fire, earthquake, nightmare, violent death, long lost relatives, etc., etc., etc., she can be forgiven. She has given us a vivid, entertaining novel.

DOROTHY DELSON KUHN

SCIENCE NOTES

By

ROBERT F. MATHEWSON

The following breeding bird list for the summer of 1956 was compiled from the observations and reports of Miss Mathilde Weingartner, Mr. Casimir Redjives, and Robert Mathewson:

Mallard Duck
Black Duck
Wood Duck
Sparrow Hawk
Woodcock
Mourning Dove
Screech Owl
Chimney Swift
Flickers
Downey Woodpecker
Crested Flycatcher
Phoebe
Alder Flycatcher
Tree Swallow
Rough-winged Swallow
Barn Swallow
Purple Martin
Crow
House Wren
Carolina Wren
Long-billed Marsh Wren
Catbird
Brown Thrasher
Robin
Wood Thrush
Starling
Red-eyed Vireo
White-eyed Vireo
Yellowthroat
Yellow Warbler
Ovenbird
Redstart
English Sparrow
Meadowlark
Red-wing Blackbird
Cowbird
Scarlet Tanager
Cardinal
Goldfinch
Towhee
Sharp-tailed Sparrow
Chipping Sparrow
Field Sparrow
Swamp Sparrow
Song Sparrow

OUR CONTRIBUTORS

MABEL ABBOTT

Author of *Life of William T. Davis;* formerly Curator of History and Literature of this Institute.

HOWARD CLEAVES

Former Curator and member of the Board of Trustees of this Institute; member of its Section of Natural History. Wildlife photographer and lecturer. Ornithologist and member of the Linnaean Society. Author of numerous articles for the *Proceedings* and other publications.

RICHARD A. DAVIS

Curator of Art of this Institute. A.B. in Fine Arts, Albion College; M.F.A. from University of Iowa. Main interests are printmaking, etching, and lithography.

KATHRINE DRISCOLL

Richmond Regional Children's Specialist, The New York Public Library. Formerly Children's Librarian of the St. George Branch Library.

OLIVE L. EARLE

Artist-naturalist. Author of children's nature books.

CARLITA NESSLINGER GEORGIA

Member of the Society of Mammalogists and Society of Parasitologists, American Association for the Advancement of Science, and a professional member of the American Institute of Biological Science. Mammalogist and embryologist on research staff of Cornell University.

DOROTHY DELSON KUHN

Member of the Belles Lettres Society and of the St. Cecilia Society; formerly taught music at New Dorp High School.

JOHN A. LE MAIRE

Professional engineer (B.S. in Electrical Engineering from Cooper Union, 1936), who has made ornithology a hobby for many years. Field secretary of this Institute's Section of Natural History.

GORDON LOERY

Formerly field secretary of the Section of Natural History of this Institute; now in charge of the education program of the White Foundation at Litchfield, Connecticut. Has Master's degree in the Science of Conservation from the Yale School of Conservation.

ROBERT F. MATHEWSON

Curator of Science of this Institute.

HUBERT J. THELEN

Vice-President of the Brooklyn Entomological Society. President of H. J. Thelen Bronze Co., Inc.

JAMES L. WHITEHEAD

Director of this Institute.

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75th Anniversary

Volume XIX
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PROCEEDINGS OF THE STATEN ISLAND INSTITUTE OF ARTS AND SCIENCES

Mildred S. Powell, ***Editor***

James L. Whitehead, ***Director and Editor of Publications***

75th Anniversary

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PROCEEDINGS OF THE STATEN ISLAND INSTITUTE OF ARTS AND SCIENCES, Vol. XIX, No. 2, Spring 1957. Published semi-annually in spring and fall by the Staten Island Institute of Arts and Sciences, 75 Stuyvesant Place, Staten Island 1, N. Y. Single copies seventy-five cents. Sent free to Museum members. Mildred S. Powell, Editor.

A PROGRAM OF NATURE EDUCATION at the WILLIAM T. DAVIS WILDLIFE REFUGE

By

JAMES L. WHITEHEAD

This and the following articles on the Refuge form a continuation of the series which began in the Fall 1956 Proceedings. The first article, "A History of the William T. Davis Wildlife Refuge," was written by Gordon Loery. The articles in this issue are concerned entirely with the botany of the area and therefore form only an introduction to the whole survey. Future articles will deal with such subjects as the geology, the mammals, mollusks, insects, and birds of the Wildlife Refuge.

We are indebted to Olive L. Earle for the art work at the beginning of each article, and to I. C. G. Cooper for the map on pages 72-73. The map is an aid to understanding the survey, and co-ordinates appear in most of the articles.

Mr. Robert Mathewson is guest editor for the series.

SINCE MAY 16, 1955, over 6000 persons, in groups of fifteen or less, have examined plants, studied flowers, peered at insects, and listened to birds on a 260-acre tract of forest, field, and swamp just out of sight of the skyscrapers of Newark and Manhattan. They have been able to do all this only because the Staten Island Institute of Arts and Sciences inaugurated, on that date, a program of nature education to be presented to as many as possible of the people of New York.

The scene of these activities, an area in New Springville, Staten Island, known as the William T. Davis Wildlife Refuge, was set up in its present form in the fall of 1954. Originally established in 1933 as a 52-acre bird sanctuary,[1] it was revived by the Institute for the specific purpose of teaching the important lessons of conservation. The New York City Department of Parks, which administers most of the city-owned land making up the Refuge, agreed to set aside and maintain the 260 acres as a wildlife refuge and give it the name of its principal original founder. In return,

[1] See Gordon Loery's article, "A History of the William T. Davis Wildlife Refuge," *Proceedings of the Staten Island Institute of Arts and Sciences,* Vol. XIX, No. 1, Fall 1956, pp. 26-34.

the Institute agreed to offer to the public a program of nature education based on guided tours along several winding trails planned by Institute naturalists and built by Park Department personnel.

As varied in terrain as any other natural area of similar size in the city, the Refuge contains salt marshes, fresh water swamps, wet woodlands, dry woodlands, open fields, tidal creeks, and swift-running brooks. Institute scientists have estimated that about 45 different kinds of trees and shrubs, 120 flowering plants, 20 mosses and lichens, 11 ferns, 250 beetles, and 32 birds, among other things, are native there. This rich variety of natural life is described in the articles in this and subsequent issues, both to record what exists there now and to justify the choice of this particular locality as our outdoor "classroom."

The Refuge is one of the few spots in all New York City where so much wildlife can be found in so small an area; and it will become increasingly valuable as Staten Island becomes more densely populated. *Nothing is so important to our present industrial civilization as the protection of our natural resources—our land, our water supply, and the precious vegetation and animal life they support—which, taken together, make up what is described in the hackneyed but all-important term, "balance of nature."*

It would be absurd, of course, to contend that the loss of these 260 acres would subtract very much from the total value of our natural resources. That is not the point. Conservation can best be taught only in direct contact with nature, and these 260 acres, centered as they are in the greatest industrial region in the world, have a value as an educational tool out of all proportion to their value in any other scale.

City people, especially, must be taught the necessity for conservation and the enforcement of suitable conservation laws. They are now in the majority and can outvote their country cousins who, presumably, understand instinctively what this is all about. Most city dwellers, if they have any interest at all in the matter, have developed it through the classroom, through reading, or through other indoor methods. Very few have had the opportunity to learn from the most effective teacher of all—nature itself.

Thus, the value of such an area as these 260 acres is incalculable, especially since they are within easy reach of a great city and can be used as the basis of an effective teaching program. It is the Institute's hope that, in time, a budget and staff of sufficient size will enable many thousands of people, especially children, to visit the Refuge and go away so much in love with nature that they will

develop and carry with them for the rest of their lives an intelligent concern for conservation.

This is an ambitious long-term program, but a good beginning has already been made. Since the Refuge was opened to the public just about two years ago, over 6000 people have been guided along the nature trails by carefully trained leaders, most of them volunteers[2] from the Institute's Section of Natural History and Junior Museum Guild. This is a large figure indeed when one considers that, in order to make the program effective for the individual, groups making the trip through the Refuge are limited to fifteen persons and each group is assigned a well-trained guide. Because of weather and change of seasons, trips are scheduled at present for only five months out of the year (roughly April 15 to June 30 and September 15 to November 30) and, because of limited staff, for only two days each week. As more leaders can be found and trained, our yearly average of 3000 can be increased many times without changing basic arrangements or lowering standards, and perhaps our present waiting list of two or three thousand a year can then be accommodated.

As it is, those lucky enough to make the trip through the Refuge take part for at least an hour in a detailed study of the important plants, rock formations, soil types, animal life, and water courses of the area, including several artesian wells, and of the ways in which all are inter-related. So important are these trips considered by the Board of Education on Staten Island that, ever since the program was started, classes have been encouraged to schedule visits to the Refuge on school time; and so important does it seem to the Department of Parks that much time and energy have been devoted to helping the Institute present as effective a program as possible.

Grown-ups, as well as children, are welcome at the Refuge. Garden clubs, P.T.A.'s, groups of professional scientists, youth leaders, and others have been taken through; and individuals, or groups of individuals up to five, are permitted to follow the trails at their leisure without a leader. Guide sheets are available, on which are listed about 50 items of special interest, all marked for easy identification by inconspicuous numbers along the trails.

Emphasis in this program, however, is being placed on young people—and rightly so—for, with their impressionable minds, they can learn more quickly and completely and can more effectively influence the course of the future.

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[2] Chairman in charge of the nature education program is Miss Mathilde Weingartner.

It is my personal belief, and I think it is shared by many others, that our whole nation, whether it consciously realizes it or not, is searching for its greatest need—a true sense of values and a way of living with more purpose and satisfaction. The study of nature under good teachers, on the spot, by a large proportion of our young people, will do as much as anything else to bring this about—especially in our cities, where we need so badly the balanced outlook, calm self-assurance, and spiritual strength which close contact with nature so frequently brings.

Several changes in the natural history of the Wildlife Refuge are expected to occur as the development of parks planned for the Fresh Kills area proceeds. The eventual closing of the tide-gate, which is to be erected at the Arthur Kill entrance to Richmond Creek, will put into operation a slow but drastic modification of the water conditions inside the gate. The level of the water will be stabilized at a somewhat lower stage than that of the present mean high tide. Instead of recurring exposures of mud at each low tide there will be a permanent lake in Richmond Creek. Main and New Springville Creeks, which form the water boundaries of the Refuge, will be arms of that lake with the same water level.

The salinity of the water will slowly be lessened, since no salt water will be admitted except perhaps in the case of very high tides during storms, when some water from the Kill may be blown over the gate. Also, the inflowing water will be fresh, because it will come from brooks which enter the area at Richmond, New Springville, and Signs Road, from seepage of underground water into the Refuge, and from rain and the run-off of rain water from the land.

The level of permanent dampness in the ground, known as the water table, will probably change slightly but will also become more definite in its depth below the surface. A large area of the marsh, which is now occasionally flooded and hence impregnated with a certain amount of salt, will have this salt washed away by the rains. The shutting out of oil and other pollution which now invades the waters will affect the acidity of both water and soil, particularly along the borders of the low lands.

These variations will have a definite effect on the fauna and flora of the Refuge.—Ed.

Topography

By

LEE A. ELLISON

A topographical model of the William T. Davis Wildlife Refuge is shown in process of preparation by Mathilde Weingartner and I. C. G. Cooper.

FROM A LOW-FLYING plane an observer might find the expanse of marsh and low woodland in Staten Island's western section between Richmond Avenue and Victory Boulevard relatively featureless and uninteresting. But if we start that observer afoot through the 260 acres of Park Department land known as the William T. Davis Wildlife Refuge, with his physical and mental eyes unobscured by the trivia of workaday affairs and let him plod westward, he should find (if he is a person of normal observing powers) much to interest him and upon which to ponder.

We are fortunate in having, in a previous issue of the *Proceedings,* an article carefully compiled by Mr. Gordon Loery, which gives a survey of the history of the Wildlife Refuge area and describes it through its beginnings as settled farm land up to the present.

Let us go back several steps in time to answer a big question of "Why?" posed by features of streams, woods, surface soil, and those few glimpses of subsurface conditions gleaned from the clinging soil of an occasional blown-over tree or from man-made diggings. Putting together as much as possible of the data thus obtained, we can arrive at certain surmises regarding some things that happened in that vast extent of time before Mr. Loery's account of human occupancy.

Were it possible to sink borings beneath this Refuge, we could expect to find bedrock about a hundred feet below the surface. Toward the eastern limit we would probably find the serpentine rock which forms the hilly "backbone" of Staten Island; in the central portions we could expect to encounter much gray sand and gravel as well as some coarse-grained gray or red sandstone. On the western limits near Victory Boulevard the possibilities are high

that we would encounter some hard, dark grayish rock of the "Palisades Sill" known among geologists as trap-rock or diabase. This lies very close to the surface along Victory Boulevard where quarrying operations were once carried on. This diabase is an extension of the once-molten magma that some 250,000,000 years ago intruded between layers of sandstone, gradually cooled and formed the natural feature known as the Palisades of the Hudson. Typical columnar rock masses of this intrusion may be traced above and below ground from West Haverstraw, N. Y., to the Sourland Hills near Princeton, N. J.

To the eastward, near the Park Department Service Yard, our drills would travel, at the greatest depths, through layers of gravel and fragments of serpentine, the latter representing an ancient "outwash" from the rock masses of Todt Hill and its connected elevations. This gravel is an aquafer or water-bearing layer upon which Richmond Borough still relies for a small portion of its summertime water needs. This rock debris and overlying layers fill an ancient valley between the serpentine hills and the elevated ridge occupied by the Palisades Sill where it approaches the condition of a surface rock at the corner of Travis Avenue and Victory Boulevard.

Our drills might occasionally bring up fragments of gray or black sandstone, trap-rock, and also coarse-grained granite and quartzite, as they bite deeply into buried boulders left by the recurring invasions of the Laurentian Glacier. This vast ice sheet began its herculean labors of reshaping the topography of New York and New England about a million years ago. Excavations now being made on the western slope of the trap-rock ridge at Travis have unearthed several hundred large glacial boulders.

Since water always seeks the lowest level, there would accumulate in the low-lying gravels within the ancient valley a reservoir of water under some pressure. As outlined in Mr. Loery's article, this pressure was a valuable asset to the old privately owned water supply companies, the capped pipes of which may be found at seven or eight places in the present Refuge area. Either because of leaky old pipes completely covered by soil, or through natural channels to the surface, there are in several places in the Refuge flowing springs or seepages bringing to the surface a cold but decidedly "hard" or mineralized and mildly alkaline water (pH 7.3 to 7.8). These sources of water and occasional layers of shallowly buried gray glacial clay (indicated by blown-over trees) have resulted in considerable variation of surface wetness.

Much the same variation may be found in those portions of the Refuge known as "salt marshes," concerning which considerable data have been gathered in drilling and other operations at the site of Consolidated Edison's new generating station at Travis. By inference as to similarity of subsoil conditions, much of interest can be learned about these areas of tidally inundated land. Water pumped from forty-foot depths in these marshes is considerably saltier than tide water. An explanation of this phenomenon might be in the evaporation of sea water at low tide and its fixation upon the surfaces of swamp vegetation that in time becomes a definite part of the soil, constituting a "meadow mat" of three to six feet thickness. Another surprising development is the presence of a large amount of dissolved hydrogen sulphide which gives to the tidal marshes a distinct "sulphur-water" odor and has its effect upon the microflora of the marshy soil.

Soil and water acidity, neutrality or alkalinity, saltiness of surface and subsoil water and silt accumulations from tidal flooding, together with seasonal variations in soil moisture, produce many "biotic niches" and "life zones" in the Refuge area. Certain trees and plants are tolerant of great ranges of conditions; others are selective over a narrow range. In shallowly depressed portions of the meadow and salt marsh area extending back from Travis Avenue between the two blocks of woodland there may be found several stands of groundsel shrub (*Baccharis halimifolia*) here growing in soil of varying degrees of salinity. It grows well in the marshes near Richmond in tidal water of typical New York Bay saltiness; this same species may be found growing on the shores of shallow lakes in the vicinity of Lake Denmark, N. J., certainly far removed from salt marshes. Contrasting with this range of adaptability we may mention sheep laurel, which is selective as to surface soil conditions and may be found in the Refuge in only a limited area in the wooded strip extending from Travis Avenue to Signs Road.

It is a long jump in time from the Age of Dinosaurs (when the Palisades were formed) to the Glacial Age, but the filling of the ancient valley and many of the present surface features represent the profound effect of Glacial and Interglacial periods, for the ice sheet advanced and retreated at least four times. During one Interglacial period, when rock debris from the melting of an ice sheet filled the lower valley of the Hudson, that river found its outlet to the sea through the Sparkill Gap, at Sparkill or Piermont, N. J., filling with muddy silt and sand, clay and gravel nearly all

of the land we now call the salt meadows from Closter, N. J., to beyond Ward's Point of Staten Island.

The present tidal streams that now enter part of the Refuge territory had their origins in the long period of melting ice and warming, moist climate that succeeded the last advance of an ice sheet. There was then, of course, a much greater outflow of water from the Island's high ground than there is at present, but the land of this area was by then so level that these streams soon became sluggish, meandering estuaries which, to a degree, they remain to the present.

Following the clearing of the land of its original forest growth by early settlers (who must have found drainage quite a problem), there resulted a complex pattern of dry, moist, wet, boggy, and saline areas. As original forests were removed by lumbering or burning, succeeding species were selective as to their preferred habitat: elm and red maple, spicebush and arrowwood sought the relatively moist localities such as we encounter almost at the start of the trail which leads from the Park Department service road through the former Bird Sanctuary tract. Oaks and sassafras and tulip trees selected the better drained land. This may be noted in the abundance of pin oak in the wooded strip stretching north from Travis Avenue, which occupies the central of three poorly defined areas of elevation of sandy loam, the western of which has been under recurrent cultivation for some time, and the eastern portion of which is now under intensive cultivation and forms a noticeable low ridge along Richmond Avenue. In these areas we may find some typical sandy-ground plants. These ridges may be traced north to Merrill Avenue, where market garden conditions were favorable until recently.

Cat-tail (which likes fresh water), creeping buttercup, some watercress and a little swamp rose mallow choose their homes along the brooksides; phragmites grass and spartina, species of Atriplex (similar to common dock) and "high tide bush" occupy the saline tidal areas. Conditions seem to be correct for a nearly pure stand of sweet gum along that portion of the old Bird Sanctuary facing Travis Avenue.

Farm land cultivation and grazing had its effects on the types of persistent vegetation, and animal life chose its most desirable habitat in the ecological complex. The present day finds us with a still greater complexity, because of the abandonment of farm land, rain erosion from burned-over places, and the invasion of tree-destroying fungi; likewise the well-intended but poorly exe-

cuted "mosquito control" drainage ditches, and many other man-made changes.

On the accompanying map of the Wildlife Refuge it has been the writer's endeavor to designate certain biotic areas or life zones, to supply a background for location for the accompanying articles to describe species' occurrences in this volume of the *Proceedings.* These we have tried to classify under very general and often remotely applicable names of classification. To simplify this scheme, it has been the writer's plan to show on the accompanying map twelve classifications of ecological conditions, thus to describe for the specific articles the localities of easily recognized conditions. In some instances these are designated by the dominant plant forms.

Variety of plant life affects all other life forms. Greenbrier tangles provide concealment for rabbits and pheasants and often for over-wintering robins and thrushes. Pin oak invites the gray squirrels; dying elms attract the woodpeckers and the "bark-pickers." Open fields attract many species of insects; fresh water marshes abounding in cat-tails persuade muskrats to build their huts there.

The accompanying articles will show how each population of living things adapts itself to fairly well defined habitats. It will be our endeavor in years to come to offer to natural history students a chance for special study in this Refuge, by its administration as a refuge, unaltered by the encroachment of urban life and the spread of home building or industry.

Diatoms

By

JOSEPH F. BURKE

An article entitled "Diatoms — for Study and Pleasure," was written by Joseph F. Burke and published in the Fall 1954 issue of the Proceedings (Vol. XVI, No. 2). In this previous article Mr. Burke describes diatoms in general, their habitats, the methods of collecting, cleaning and mounting them, and cites literature and reference material for the student of diatoms.

DIATOMS OF THE Wildlife Refuge occur in both fresh and salt water, as the following habitats indicate—

HABITATS:[1]

I. Brackish water diatoms of Main Creek and ditches on the adjacent meadows.(B9-Z8, C1-Z8)

II. Freshwater diatoms of the original Bird Sanctuary area, particularly of the location at the artesian well and brook.(B8-Y3)

III. Freshwater diatoms of Willow Brook entering into upper end of Main Creek.(C8-Z8)

Freshwater diatoms,(II and III) as they flower, are apt to remain at the original location, although some are carried downstream by the flow of water.

Brackish water diatoms (I) are subject to the influence of the tide, and may remain relatively stable in the ditches of the meadows where the tidal action is gentle and where they are not dispersed to any great extent. In the creek itself, where they are more subject to the movement of the water as the tide flows in and out, favorable conditions for a given collection may exist only on one tide and then for a relatively short time, perhaps a few minutes. Diatoms of the muddy edges of the creek remain relatively undisturbed from tide to tide.

[1] Roman numerals, I, II, and III, occurring in the text and appended list, refer to habitats so designated at the beginning of this article.

In a survey of an area, such as the one under consideration,[1] collecting should be repeated over a period of several years. What is missed one year may be gathered the next. Here is an illustration. An early interest in the genus *Amphiprora* led to a comprehensive study of the genus. Repeated collecting on Staten Island failed to turn up the largest of the salt water species *Amphiprora pulchra.* Persistent collecting ultimately produced a fine gathering of the species in the meadows below the Travis Avenue bridge.

Off the south shore of Staten Island, in the waters of the Lower Bay, which meet the open sea beyond Sandy Hook, a marine flora can be expected. Collections may be made by dredging. In such collections there might occur diatoms of the genera *Coscinodiscus, Triceratium, Biddulphia, Actinocyclus, Actinoptychus,* and others of the Centrales.[2] These are the diatoms of the continental shelf and the inlets of the ocean.

In general, we do not expect to find such diatoms in the less salt waters of the New Springville area. Rather the diatom flora runs more to the Pennales,[3] with such genera as *Amphiprora,* already mentioned, *Gyrosigma, Pleurosigma, Caloneis, Navicula, Diploneis, Mastogloia,* and especially the well known *Bacillaria paradoxa.*

This assignment of genera to a type of locality is a generalization convenient to thinking in broader terms. Some of the above mentioned genera may be represented by a few species in the other type of location. Such overlapping of genera occurs not only in marine and brackish waters, but into freshwater as well. An instance of this is found in the meadow gatherings.[1] The genus *Pinnularia* is predominantly a freshwater one, but some occur in salt water. *Pinnularia aestuarii,* a halophile diatom (salt-loving), is found in the ditches of the meadows.[C1-Z8]

Some unusual diatoms were found in the Wildlife Refuge. *Cylindrotheca gracilis,* for example, was unrecorded by Boyer for North America, although reported in California by Mereschkowsky. This fragile form must be looked for in untreated material, as acid destroys it. I have found it also in an untreated collection sent to me from Florida. *Gyrosigma temperei* is reported by Boyer as known only from the type locality in Connecticut. *Navicula creuzbergensis* is unrecorded in Boyer for North America. *Tropidoneis van heurckii maxima,* discovered in Puerto Rico by Hagelstein, is

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2 Structure arranged in relation to a central point with outlines circular, elliptical or polygonal.

3 Structure arranged in relation to a median line with outlines boat-shaped, rod-shaped, crescent-shaped or sigmoid.

not in Boyer. I have observed it on a slide from Jacksonville, Florida, prepared by C. Van Brunt.[4] In Boyer, *Surirella palmeri* is localized to eastern Pennsylvania.

LIST OF DIATOMS

Achnanthes brevipes Agardh I
Achnanthes lanceolata (Bréb.) Grun. ..... I, II, III
Amphiprora alata Kütz. I
Amphiprora conspicua Grev. I
Amphiprora paludosa W. Sm. I
Amphiprora pulchra Bailey I
Amphora holsatica Hust. I
Bacillaria paradoxa Gmelin I
Caloneis formosa (Greg.) Cleve I
Cylindrotheca gracilis (Bréb.) Grun. I
Diploneis smithii (Bréb.) Cleve I
Fragilaria harrisonii (W. Sm.) Grun. II
Frustulia vulgaris (Thwaites) De Toni ..... I, II
Frustulia vulgaris var. *asymmetrica* Cleve I
Gomphonema acuminatum var. *coronata* (Ehr.) W. Sm. II
Gyrosigma obliquum (Grun.) Boyer I
Gyrosigma temperei Cleve I
Mastogloia exigua Lewis I
Mastogloia pumila (Grun.) Cleve I
Melosira nummuloides (Dillw.) Agardh I
Melosira varians Agardh ..... II, III
Meridion circulare var. *constricta* (Ralfs) Van Heur. II
Navicula attwoodii Perag. I
Navicula creuzburgensis Krasske I
Navicula cuspidata Kütz. II
Navicula hennedyi W. Sm. I
Navicula integra (W. Sm.) Ralfs II
Navicula minima var. *atomoides* (Grun.) Cleve III
Navicula mutica Kütz. I

[4] "Collection of New York Botanical Garden."

Navicula mutica var. *cohnii* (Hilse) Grun. I
Navicula pelliculosa (Bréb.) Hilse II
Navicula peregrina (Ehr.) Kütz. I
Navicula placenta Ehr. I
Navicula protracta Grun. I
Navicula pupula Kütz. . . . . II, III
Navicula radiosa Kütz. III
Navicula spicula (Dickie) Cleve I
Navicula yarrensis Grun. I
Neidium iridis var. *ampliata* (Ehr.) Cleve II
Nitzschia acicularis W. Sm. II
Nitzschia acuminata (W. Sm.) Grun. I
Nitzschia bilobata W. Sm. I
Nitzschia granulata Grun. I
Nitzschia plana W. Sm. I
Nitzschia scalaris (Ehr., c. p.) W. Sm. I
Nitzschia tryblionella var. *levidensis* (W. Sm.) Grun. I
Pinnularia aestuarii Cleve I
Rhoicosphenia curvata (Kütz.) Grun. II
Rhopalodia musculus (Kütz.) O. Müll. I
Stauroneis phoenicenteron Ehr. II
Surirella gemma Ehr. I
Surirella ovata Kütz. III
Surirella palmeri Boyer II
Synedra (*Fragilaria*) *parasitica* (W. Sm.) Hust. II
Tropidoneis van heurckii var. *maxima* Hagelstein I

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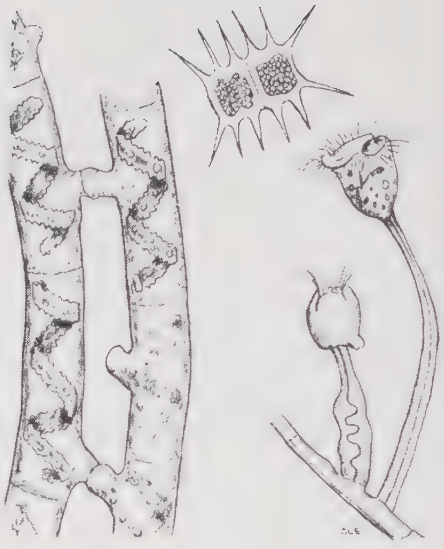
Microscopic Life

By

I. C. G. COOPER

PART I — ALGAE

PART II — PROTOZOA — to be published in the Fall 1957 issue of the *Proceedings*



No natural history survey can be considered to be complete without a report on microscopic life. The protozoa, fungi, algae, bacteria and worms are everywhere invading and occupying space and surface of soil and the plants and trees growing upon it. Many of these life forms are intimately associated with and are particularly affected by water conditions. These forms will be among the first to be influenced by changing conditions and, therefore, may be studied as indicators of the changes.

PART I—ALGAE

An inquiry into the nature and extent of the invisible plant life was commenced in 1954 when interest in the Wildlife Refuge was revived. The average observer may perhaps notice some greenish scums on stagnant pools, filaments on the stems of submerged plants, or a coating on the wettest side of an old tree. Apart from these few occasions there is little evidence of the microscopic plants known as *algae.*

There is little standing water in the Refuge which might be explored for visible growths of algae. The creeks and ditches are badly coated with a scum of oil, and small run-off stream beds are often dry. The investigator must therefore seek in other places for his material.

Algae can be carried on the surface of blown dust, by the feet

and beaks of birds, by the feet and tongues of insects, and by percolating water. By one or all of these means the cells have been distributed almost universally. One good source of supply for these plants is the soil near the surface of the ground. Direct examination of soil samples, however, is most unrewarding. The sample must be cultured, often over many months, to enable the microscopic cells to divide and accumulate to a volume which can be recognized and handled.

The culturing of algae is done in miniature ponds, using special nutrient solutions designed to provide the necessary elements for the growth of the plants. Conditions of light, temperature, and concentration of the nutrients in the fluid are controlled and sterile technics are used to prevent introduction of unwanted growths.

Soil samples were collected from a variety of spots such as damp edges of streams and ditches, moist and dry soil situations, trees, and from under fallen leaves on the floor of the woodland. More than sixty samples have been cultured and from each at least one alga has been recorded.

There are very few algae of marine type in the Refuge area. Floating pieces collected have all been interlopers from the nearby bay. On the edge of the marsh there is a thin mat which sometimes takes on a greenish tinge, and in this can be found a tangled net of *Rhizoclonium riparium* and also a species of *Vaucheria.* These are essentially algae of brackish water. The *Vaucheria* has not been found in fruiting condition, so its specific name is still undetermined.

All the other algae recorded are exclusively types which live on soils free of excessive salt or in fresh water. They are generally of blue-green or green color and grow as separate cells or in simple or branched filaments, which may be either free or in a mass of gel.

There are two points where flowing water enters the Refuge area—one at the extreme northwest corner where culverts from Signs Road enter Main Creek,(C9-Z8) and the other at the southeast end where New Springville Brook flows past the Park Department yard.(B9-Y3) Each has a few algae peculiar to the location. From the first place has been collected *Pediastrum simplex,* a neat little colonial alga in star-like disks, and *Oscillatoria splendida,* a delicate filament having a diameter less than one eight thousandth of an inch. From the second place *Vaucheria geminata* was found in full fruiting stage and thus readily identified.

The algal records so far obtained seem to be scattered quite irregularly and no particular patterns of distribution have been developed.

LIST OF ALGAE

Ankistrodesmus falcatus
Arthrospira jenneri
Charcium ambiguum
Chlorella vulgaris
Closterium moniliferum
Chrococcus turgidus
Merismopoedia tenuissima
Microcystis incerta
Microthamnion kuetzingianum
Oscillatoria granulata
Oscillatoria limnetica
Oscillatoria major
Oscillatoria splendida
Pediastrum simplex
Phormidium tenue
Protococcus viridis
Scenedesmus quadricauda
Schizogonium murale
Spirogyra spreeiana
Spirulina laxissima
Stichococcus bacillaris
Stigeoclonium subsecundum
Tribonema bombycinum
Ulothrix subtilis
Vaucheria geminator

The following organisms have been determined only as to genera.

Anabaena *Chlamydomonas* *Nostoc*

Bryophytes and Lichens

By

LEE A. ELLISON

AMONG THE "LITTLE FOLKS" that contribute their bit towards making the wooded and open areas of the Refuge beautiful, we should include those humble and little-noticed plants known as

mosses, hepatics and lichens. The first two are to be found in the moist areas of the Refuge, near the freshwater marshes and beside flowing streams; lichens can tolerate quite dry conditions of soil and are found chiefly in the grassy fields.

In the wooded strip that has been most completely developed for public use there are many mosses. In some cases there has been a succession of different species in a small locality. For instance, the overflow from the artesion well in the southeast corner of the Park Department service yard (CY-Y3) has seen from year to year the green water-loving moss *Amblystegium irriguum,* followed by *Amblystegium riparium* and *Amblystegium varium.* Sphagnum or peat mosses, noted for their affinity for water, are nearly absent from the Refuge.

Where the banks of New Springville Brook (B8-Y3) merge with the dense growth of phragmites but retain a boggy character, we may find in season the pale green moss *Aulacomnium palustre* bearing clustered gemmae on slender stalks but, like its opposite species of the drier areas such as the wooded strip between the farm areas, Ohio Haircap, *Polytrichum Ohioense,* seldom if ever fruiting. "Catharine's Moss," *Atrichum crispum,* common in wooded clearings, is occasional to rare in the Refuge.

Beside paths in the Refuge where the soil is compact and moderately dry, our commonest species is the densely matted small moss *Dicranella varia.* This is one of the commonest species of Staten Island. In similar localities we find Matted Bryum, *Bryum caespiticium,* calling our attention in early spring by its abundance of pendent, pear-shaped, pale green capsules.

Haircap or Pigeon Wheat as a genus is represented by only one species, *Polytrichum Ohioense,* occurring in little moist depressions in the drier woods extending from Travis Avenue to Signs Road.(C3-Z1) Along a stub of access road in this area there occurred last spring a scarce survivor of a moss once abundant here but rare since the coming of frequent brush fires: *Pleuridium subulatum,* a "pygmy moss."

In continually wet places such as seepages from the artesian water sources and in the marsh beside Vreeland's Brook,(B9-Y9) we find a bright-to-pale green decumbent moss, *Amblystegium varium.* This and other species of the genus are very common on Staten Island. They are abundant in the wet localities of the western block of woods in the Refuge. Near Vreeland's Brook,(B9-Y9) many

small mounds about tree bases or covering small decayed stumps are carpeted with a small moss, *Georgia* (*Tetraphis*) *pellucida,* unique in bearing little flowerlike gemma cups.

Of Hepatics, which nearly always prefer wet ground, and whose fruiting season is often a few days only, there are three common species: straplike thalli of *Pallavicinia Lyellii* on banks beside the path which crosses Vreeland's Brook (C0-Y8); and lettuce-like *Pellia epiphylla* on the brook's banks. Much of the closely knit, velvety sod which occurs in the more open grassy areas is a green to dark purplish brown growth of the leafy hepatic *Odontoschizma prostratum.* Seldom seen hepatics include *Lophozia excisa,* once found at the base of a dying elm tree near the pathway entrance.

Lichens may be found in the grassy field south of the Winant block of woods in the field along Travis Avenue, (B9-Z1) and in several other quite dry localities. All the representatives of these plants found in the Refuge belong to the genus *Cladonia,* and particularly the species *cristatella, coniocraea,* and *subcariosa.* They fruit infrequently here, but occasionally one may find well developed fruiting heads of the species cristatella—the "British Soldiers" or scarlet fruited lichen. They are most apparent in the cool, moist weather of early spring and late fall. An outstanding example of Nature's wisdom, they are a plant partnership—alga and fungus—and during damp weather the pale green of the alga partner (the food supplier) shows through the white tissue of the fungus.

In common with all similar locations on Staten Island, these are the most common bryophytes and lichens. Likewise there is a common absence in the Refuge as well as the rest of the Island, of mosses that inhabit tree bark.

The nomenclature used in the list follows the system of A. J. Grout, *Mosses with Hand Lens and Microscope.*

LIST OF BRYOPHYTES AND LICHENS

Georgia (*Tetraphis*) *pellucida*
Polytrichum Ohioense
Atrichum crispum
Dicranella varia
Aulacomnium palustre
Pleuridium subulatum
Bryum caespiticium
Amblystegium irriguum
Amblystegium riparium
Amblystegium varium

Ferns

By

MATHILDE WEINGARTNER

CULTIVATION, DRAINAGE, BRUSH FIRES, and other conditions attendant upon human habitation have brought about effects detrimental to the ferns which at one time were found in great numbers at the William T. Davis Wildlife Refuge. At the conclusion of this article there is a listing of the species that I have found during a number of years' work in the area.

The sensitive fern is the most common fern not only in the wetter localities but probably throughout the area. This plant carries its spore-capsules on separate stalks which stand up straight like brown beaded spears all through the winter. The sensitivity of this plant to extremes in temperature and dryness of soil has earned for it the common name, "sensitive fern." Nevertheless, its root stocks are sturdy, and the plant will put out new growth as soon as conditions permit. Forms similar to the modern sensitive fern are found in cretaceous fossil beds, implying that it has ancient lineage.

The marsh fern also favors wet, sunny places. It can be recognized by its very long stipe (or stem), which gives the plant the appearance of holding up its "skirt" out of the marshes. The foliage leaflets have forked veins, and in the blades the edges of the leaflets are rolled back over the spore-cases. Once the spores are ripe, the leaves uncurl and liberate them to float away on the breeze. The blade usually has a bluish midrib and is inclined to have a characteristic twist. If the plant grows in a shady place it will produce only foliage leaves.

The royal fern, which usually grows in wet situations, never-

theless readily adapts itself to drier soil, and is almost universally distributed. It is an outstanding plant, easily identified by its stiff, erect stipes carrying but a few large regular pinnate leaflets, and by an erect, rigid, torchlike terminal spike of cinnamon color.

Equally fond of wet places is the cinnamon fern. It is so called because of the cinnamon-colored fertile tip of its blade, which fruits in early June. This fern is perhaps most easily recognized in its "fiddle-head" stage when it is very woolly. The fuzzy tufts of down persist in the axils of the leaflets all through the season. This species has a very heavy cluster of roots, in which the stalk growth from former years persists.

In the wet woodlands of the Wildlife Refuge we may also come upon the spinulose shield fern. One of a large family of wood ferns, it inhabits wet and drier woodlands. The spinulose shield fern usually does well in shady places; if exposed to considerable sunlight it loses its lush green color and turns a yellowish green. The non-spore-bearing leaves remain green all winter long—characteristic of most wood ferns. Formerly, many of the wood ferns were picked in great numbers for the use of florists.

The closely related crested shield fern has a very narrow blade and large fruit dots. It grows along the edge of streams and in very wet meadows, often standing up above the other vegetation. In 1937 the writer saw this fern in the region of the Freeman Winant swamp.(B8-Z3) Growth in the surrounding area has since become so dense and impenetrable that I have not been able to get through to search for it in recent years. It is highly probable that the plant still exists in that woodland.

A less common inhabitant of the elevated and drier woodlands is the ternate grape fern. Its sporophyl (fruiting stalk) branches off near the base of the stem, and the spores mature in September and October. This plant persists throughout the winter, its leaves turning a deep red color.

When it is dry, the hay-scented fern, with its lacy, delicate leaves, has the aroma of new-mown hay. This plant prefers roadsides and sunny situations, but will also grow in dry woodlands. It is one of the ferns that can be found on the northeast side of Travis Avenue.(C0-Z3)

The lady fern is very common on Staten Island. Occasionally the stipe is reddish, especially at its base, and is covered with brownish scales. One of the most variable of our ferns, it is difficult to identify. It grows in meadows and brush land and on the edges of woodland.

Bracken ferns, having a quite varied habitat, naturally are found in the Wildlife Refuge. They grow in the light shade of woodlands, shrubby borders, and often in barren fields, from the tree line of Canada to the Florida Everglades. These ferns are easily recognized by their large triangular blades and also by the fact that the edges of the leaflets are curled down over the sporecases. They are rapid growers and can withstand considerable damage by fire.

The field horsetail is the only fern ally known by the writer to grow in the Refuge. It is one of the oldest plants on earth. Above the ground these plants are annuals, but below the ground they are perennials and long-lived. The plant's form is symmetrical, its branches growing in regular whorls. The short-lived fertile stem, which comes up before the sterile one and fruits in April or early May, contains no chlorophyl. The spores have tiny thread-like elaters which, because they are susceptible to moisture and curl and uncurl, aid in the dissemination of the spores.

The more recently evolved ferns which populate the Wildlife Refuge today had their prototypes in the vegetation of the carboniferous forests.

LIST OF FERNS

Botrychium dissectum Spreng. var. *obliquum* (Muhl.)	Ternate grape fern
Osmunda regalis L.	Royal fern
Osmunda cinnamonea L.	Cinnamon fern
Onoclea sensibilis L.	Sensitive fern
Dennstaedtia punctilobula (Michx.) Moore	Hay-scented fern
Thelypteris palustris Schott	Marsh fern
Dryopteris cristata (L.) Gray	Crested shield fern
Dryopteris austriaca (Jacq.) Woynar var. *spinulosa* (Mull.) Fiori	Spinulose shield fern
Athyrium Filix-foemina (L.) Roth	Lady fern
Pteridium aquillinum (L.) Kuhn	Brake or Bracken fern
Equisetum arvense L.	Field horsetail

REFERENCES

Britton and Brown, *Illustrated Flora of the Northeastern United States and Canada.*

Farida A. Wiley, *Ferns of the Northeastern United States.*

Boughton Cobb, *A Field Guide to the Ferns.*

John Kunkel Small, *Ferns of the Vicinity of New York.*

Grasses

By

ROBERT C. MEYER

Of all the plants in the Wildlife Refuge, the grasses receive the least attention, perhaps because they are so constantly underfoot. Except in the case of the turf manager of a golf course, or a home owner struggling to establish a fine green lawn, grass to most "city folk" is just grass. Only in the drought-ridden range lands of the Southwest has the full importance of native grasses, as a means of stemming the tide of a new and spreading dust bowl, been realized. But even the tough native grasses of that area will wither and die during a severe drought. We in the eastern part of our country are fortunate in having an abundance of precipitation to keep our fields and woods green most of the time. Locally, the trees and shrubs with their abundance of fruits, berries, or multicolored leaves, and the beautifully colored wild flowers, offer the greatest attraction to the general public and to the younger generation in particular.

As with other species of plants, grasses, too, have flowers which bloom at various times of the year for the different species. Grass flowers consist of a cluster of stamens (generally two or three) and a pistil with a pair of feathery stigmas, all of which are enclosed in a pair of tiny leaf-like bracts called the "lemma" (on the outer side) and the "palea" (on the inner side). The colorful parts of a grass flower are the anthers, which range from a bright orange in our common switch grass to a pale lavender in some specimens of timothy. The plume-like stigmas of the grass flowers are often similarly brightly colored. These colorful parts, to be fully appreciated, must be observed closely under a hand lens or magnifying glass.

The layman recognizes most of the grasses by their general appearance rather than by careful study under a hand lens. Most of us are familiar with the tall, plume-like flowering heads of the phragmites growing along the edge of the salt marsh in the Refuge. This tall reed grass is the ever present tinder for grass fires. Another familiar grass which grows at the edge of the salt marsh and in the abandoned fields nearby is the switch grass. This grass has a large, pyramidal head (panicle) which is easily recognized by its beautiful orange stamens at the time of flowering. Both the switch grass and phragmites have the ability to tolerate a partially saline soil, which explains why they are able to grow at the edge of the salt marsh in the Refuge.

A number of grasses are found growing in the salt marsh, as well as a plant called "black grass," which is not a grass but belongs to the Rush family. In the deeper water along the edge of the tidal creek, smooth cord grass is found growing to a height of four to five feet. Farther back from the edge of the creek another tall grass is found, growing six to eight feet in height, commonly known as salt reed grass. The main portion of the salt meadows (which were formerly cut for salt hay) is covered with alkali grass, salt meadow grass, and the "black grass" previously mentioned. These comparatively small grasses, growing one to two feet high, cover most of the fast disappearing tidal marsh areas of Staten Island.

The wood reed grass is the only shade-loving grass that is found in the deep wooded area of our Refuge. It is quite noticeable during August and September, when its beautiful nodding panicles may be seen along the paths near the old grapevine on the west side of Travis Avenue.

Two grasses, white grass and "fowl manna" grass, are found growing on the moist and muddy banks of the small freshwater streams that run through the Refuge. Fowl manna, the taller of the two, attaining three to four feet in height, has seeds which, when ripe, drop off at the slightest touch. This species is often found growing next to the prolific stands of jewel weed. White grass is pale green, delicate, and thin, and grows along the partially shaded paths in the Refuge.

In the open fields near the old farm on the east side of Travis Avenue, (C1-Z1) switch grass and Virginia beard grass have taken over land which was previously cultivated. A few clumps of blue stem grass, too, grow in this area. These beard grasses flower in late summer or early fall and are generally quite brown or pur-

plish brown before they reach maturity. All three of these grasses are perennials and form heavy sods which remain as blackened clumps whenever burned over. (We are fortunate, however, that brush fires are quite rare in the Refuge.)

Both sides of the Park Department service road and Travis Avenue provide favorable habitats for the many species of grasses found growing there. This environment favors the full effect of seed dispersal. Seeds are brought here in the muddy treads of tires, the corners of grill work, and the greasy undercarriages of automobiles. Dropping continuously on the roadway, the seeds blow into habitats where abundant sunshine and ample run-off water enable them to germinate readily, and often add new species to our records of plants. Among the grasses most commonly found along Travis Avenue are, in the order of their time of blooming, Kentucky blue grass, orchard grass, sweet vernal grass, timothy, red top, and panic grass.

In general, the same grasses appear year after year in the Wildlife Refuge. Occasionally newcomers along the highway may grow for a year or two before succumbing to competition from our local species. There are few rarities. The annual reappearance of the regular group of grasses can be depended upon, and these forms represent a good number of the species' population on Staten Island. It may be safe to say that, except for a few sandy soil and rocky upland grasses, more than 75 per cent of the kinds of grasses now growing on Staten Island could grow in the Wildlife Refuge.

LIST OF GRASSES

A. Along Travis Avenue from tidal creek to Park Department Service Road:

Poa pratense	Kentucky blue grass
Poa trivialis	Rough stemmed meadow grass
Poa annua	Low spear grass
Poa compressa	Canada blue grass
Anthoxanthum odoratum	Sweet vernal grass
Dactylis glomerata	Orchard grass
Agropyron repens	Quack grass
Phleum pratense	Timothy
Festuca elatior	Meadow fescue
Bromus commutatus	Brome grass
Agrostis alba	Red top grass

Puccinellia distans	Salt spear grass
Holcus lanatus	Velvet grass
Panicum clandestinum	Panic grass
Panicum dichotomiflorum	Smooth panic grass
Panicum microcarpon	Panic grass
Digitaria sanguinalis	Tall crab grass
Digitaria ischaemum	Smooth crab grass
Setaria glauca	Yellow foxtail grass
Setaria viridis	Green foxtail grass
Echinochloa crusgalli	Barnyard grass
Eleusine indica	Goosefoot grass
Elymus virginicus	Virginia wild rye

B. Grasses in old field east of Travis Avenue:

Panicum virgatum	Switch grass
Panicum dichotomiflorum	Smooth panic grass
Panicum microcarpon	Panic grass
Andropogon virginicus	Virginia beardgrass
Andropogon scoparius	Blue stem grass
Setaria glauca	Yellow foxtail grass
Setaria viridis	Green foxtail grass

C. Grasses in wooded (shady) area:

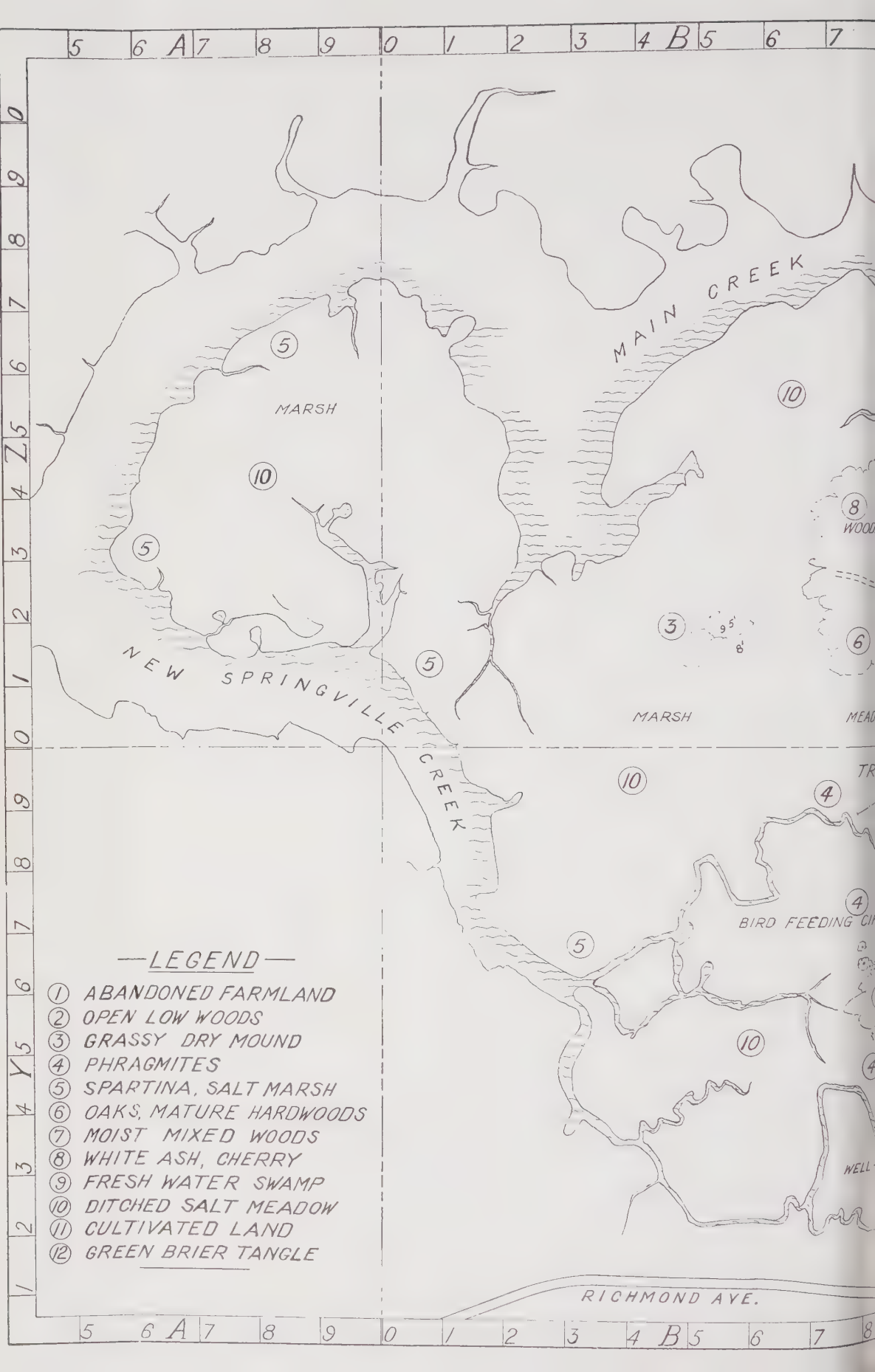
Muhlenbergia Schreberi	Nimblewill
Muhlenbergia mexicana	
Leersia virginica	White grass
Cinna arundinacea	Wood reed grass
Glyceria nervata	Fowl manna grass

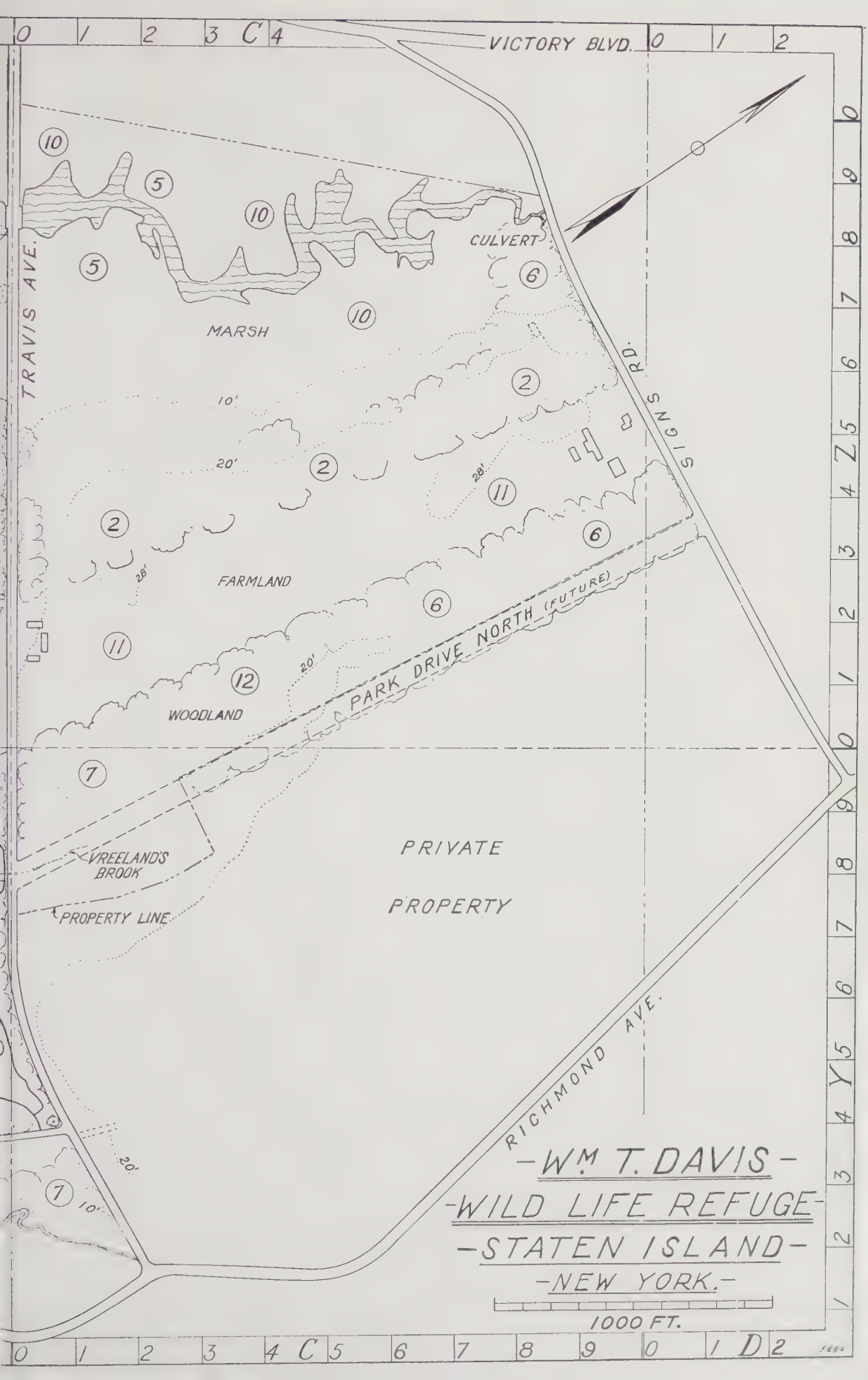
D. Grasses at edge of Park Department dump (burning area):

Tridens flavus	Tall red top
Eragrostis major	Stink grass
Panicum capillare	Old witch grass

E. Grasses in salt marsh or at edge of salt marsh:

Phragmites communis	Tall reed grass
Spartina cynosuroides	Tall cord grass, salt reed grass
Spartina alterniflora	Smooth cord grass
Spartina patens	Salt meadow grass
Distichlis spicata	Alkali grass


MAIN CREEK
MARSH
NEW SPRINGVILLE CREEK
MARSH
BIRD FEEDING
RICHMOND AVE.
—LEGEND—
(1) ABANDONED FARMLAND
(2) OPEN LOW WOODS
(3) GRASSY DRY MOUND
(4) PHRAGMITES
(5) SPARTINA, SALT MARSH
(6) OAKS, MATURE HARDWOODS
(7) MOIST MIXED WOODS
(8) WHITE ASH, CHERRY
(9) FRESH WATER SWAMP
(10) DITCHED SALT MEADOW
(11) CULTIVATED LAND
(12) GREEN BRIER TANGLE


VICTORY BLVD.
TRAVIS AVE.
SIGNS RD.
CULVERT
MARSH
FARMLAND
WOODLAND
PARK DRIVE NORTH (FUTURE)
PRIVATE
PROPERTY
VREELAND'S BROOK
PROPERTY LINE
RICHMOND AVE.
10'
20'
28'
-WM T. DAVIS-
-WILD LIFE REFUGE-
-STATEN ISLAND-
-NEW YORK.-
1000 FT.

Flowering Plants

By

I. C. G. COOPER

THE WOODLANDS of Staten Island have their own unique distinctions. This is quite noticeable in the various sections of the Wildlife Refuge. The earlier use of the land naturally has had an influence on the present flora. The vegetation of some parts of the Refuge, in terms of ecology, is very young. Plants frequently found in similar woodlands in other parts of Staten Island are missing from the Refuge, and so its woods and fields have their own characteristics.

An illustration of this condition is furnished by the wooded strip lying between the main path, from the entrance to the bird feeding circle, and Travis Avenue. (B8-C0, Y5-Y8) This strip was apparently cultivated as farm land until the turn of the century. The surface was cleared of large drift boulders which now lie in the old wall. The elms, now mostly fallen, were close to the road. The present tree coverage is almost completely sweet gum, probably less than fifty years old. The shrub covering is mainly spicebush. Since both sweet gum and spicebush make considerable shade, there is little distinctive ground flora. There are no spring beauties, violets, ferns, or wood asters; there are few trout lilies and little grass. Towards the strip's eastern end, (C0, Y4-Y5) Japanese honeysuckle provides a covering for the ground and fallen tree trunks. Grapevines, climbing poison ivy and Virginia creeper can and do compete for the sunlight by climbing to the tree tops.

At the point where Vreeland's Brook enters the wooded strip, (B9-C0, Y8) there is a freshwater swamp. The tree coverage is more varied and it is the home of jewel weed, skunk cabbage, cat-tails,

climbing boneset, fireweed, watercress, creeping buttercup, jack-in-the- pulpit, and a strong growth of sensitive fern. There are a few asters, including the beautiful New England aster, and a tangle of grasses.

Where the ground rises slightly, beyond the swamp, (B9-C0, Y8-Y9) there is an area of well drained soil bearing stands of mixed trees. There are some glades. The ground cover is more varied and includes wild leek, wild garlic, wild strawberry, enchanter's nightshade, dead nettle, and some real as well as false Solomon's seal. In the open spaces Joe Pye weed, goldenrods, false climbing buckwheat, wild rose, and several varieties of grass appear.

The meadows lying between the Refuge and Winant's wood (B8-C0, Z0-Z2) have been released from cultivation comparatively recently. Trees have not yet become established. The present ground cover has not become stabilized. The usual weeds of neglected farms have disappeared but the dominance of the succession is not yet settled. Brambles and the stronger goldenrods push in from the west, wild parsnip presses from the south, and milkweed from the east. Which will win? If trees should get a foothold, probably none.

The section beyond the meadow, (B8-C0, Z2-Z5) known as Winant's wood, was apparently much disturbed at one time by the activities of the water company. The partially swampy character of the soil has resulted in a heavy tangled undergrowth which has not yet been fully investigated. In part, this is because there is a desire that the section should be preserved in as natural condition as possible for wildlife other than the flora. That policy will help to compensate for the disturbance possibly caused by using the Refuge for educational purposes. In general, the flora of Winant's is similar to that of the other wet areas.

The ground cover of the marsh is limited in the variety of plants growing there. The growths roughly parallel the edges of the main waterways in a definite pattern. Next to the water there is the heavy spartina grass and then the salt meadow grass. The bulk of the flat land is the home of the high-tide bush, and at the edge of the tidal flat there is a transition zone where seaside goldenrod grows. Mixed with these is the halbert-leaved orache.

Change in elevation of the ground strongly affects the character of the woodlands growing upon it. The strip between Travis Avenue and Signs Road (C0-D1, Z0-Z4) which surrounds the upper course and source of Vreeland's Brook reaches a height of 26 feet

above the mean high tide level. The vegetation there is probably of longer standing than any to the immediate west of it. The irregular surface, marshy spots and surface stones made this land unsuitable for farming. Although disturbed by traffic there is still a wide variety of flora there. In a large area the ground has been covered by greenbrier, but where the shade of the trees is not too heavy ferns find an opportunity to flourish; and in some open spaces the bayberry, blueberry, a giant wild sunflower, dogbane, boneset, and evening primrose are found.

Opportunity to observe the invasion of weeds on the partially neglected farm land adjacent to the woodland has been very restricted. Several plants such as bindweed, bed straw, ragweed, knotweed, henbit dead nettle, iron weed, and field camomile have been noted.

The marsh to the north of Travis Avenue is a continuation of that to the south and tapers off into the wild cherry woods at Signs Road.

The growths by the roadside must also be included as an integral part of the flora of the area. Along Travis Avenue may be found such common plants as the ragweeds, wormwood, clovers, buttercup, plantain, knotweeds, and millefoil. These have been included in the list which follows.

We are indebted to and appreciative of the assistance given by Mr. Joseph Monachino of the New York Botanical Garden in identifying some of the lesser known plants.

The nomenclature used in the list follows that adopted by Dr. Henry A. Gleason in the *New Britton and Brown Illustrated Flora* (1952).

LIST OF FLOWERING PLANTS

Typha angustifolia	I-70*
Typha latifolia	I-70
Symplocarpus foetidus	I-369
Allium tricoccum	I-412
Lilium superbum	I-418
Erythronium americanum	I-420
Maianthemum canadense	I-426
Smilacina racemosa	I-426
Uvularia sessilifolia	I-428
Polygonatum biflorum	I-430
Smilax glauca	I-436

* Numerals refer to volume and page in *New Britton and Brown Illustrated Flora*, 1952 ed.

Shrubs and Vines

By
HARRY BETROS

WITHIN THE BOUNDARIES of the William T. Davis Wildlife Refuge, nineteen species of shrubs and twelve species of vines can be found. To differentiate in this paper between a tree and a shrub, by definition a shrub is a woody perennial with multiple stems arising from the base.

Plants prefer a specific environment within which they are most likely to survive; therefore, we shall attempt to group the shrubs and vines in accordance with their environmental preferences. In order to provide an accurate study of the plants of a given area, they should be studied as a plant community rather than as individuals.

ELM-MAPLE-HONEYSUCKLE ZONE (C1-Y3)

The American elm and red maple are the principal trees found in this zone, in company with scattered black cherry, sweet gum, and ash. Arrowwood is the dominant shrub, with some elderberry, spicebush, and pokeweed. Japanese honeysuckle covers most of the

woodland floor as well as some of the shrubbery. A few small patches of blackberry can be found, as well as scattered grapevines and climbing hempweed.

Cat-tail Marsh (B9-Y8)

The cat-tail is the dominant plant found in this marsh, and there is also a scattering of sensitive fern and willow. A few specimens of hornbeam, hawthorn, poison sumac, arrowwood, spicebush, and red osier can also be found. Beyond the cat-tail marsh extensive areas of common reed grass (phragmites) may be seen.

Dry Thicket (B9-Y9)

This zone is characterized by a few trees such as mulberry, ash, black cherry, hawthorn, and June berry, none of which is found in quantity. Shrubs include arrowwood, dogwoods, and an occasional blueberry. Bittersweet clings to an old fence running to the southeast of Travis Avenue, and wild grape and climbing hempweed drape many of the neighboring trees and shrubs.

Poison Sumac-Onoclea Marsh (B8-Y6)

Along the fringes of the marsh a concentration of poison sumac exists, punctuated by scattered willows and ash. Cat-tail, sensitive fern, and willow-herb are found in abundance. The vine, climbing hempweed, and the shrubs, red-osier dogwood, spicebush, and arrowwood are found here.

Benzoin-Arrowwood Zone (C1-Y6)

Ash, sweet gum, and black cherry dominate the upper story of this zone. The principal shrubs are arrowwood and spicebush, with scattered specimens of smooth sumac and autumn witch-hazel. Climbing hempweed and grape can be found threading their way over trees and shrubs, and poison ivy can be seen clinging to the bark of trees.

Sweet Gum Stand (C0-Y5)

Situated in a large strip running parallel to Travis Avenue and south of it, sweet gum is found in predominance with scattered specimens of red maple, black cherry, and ash. Scattered spicebush and arrowwood grow in this zone. Japanese honeysuckle is abundant, and Virginia creeper and poison ivy cling to the bark of trees.

The Vreeland Strip (C4-Z1)

The swamp adjacent to and north of Travis Avenue is dominated by such shrubs as spicebush, arrowwood, and elderberry. Here the vines are false buckwheat, climbing hempweed, and bittersweet. Wild cherry, poplar, and hornbeam are the trees that form the upper story. Just west of this swamp is a large stand of sassafras.

Inland, under a canopy of red maple, ash, and oak, one finds a small, compact stand of sheep laurel. Dwarf sumac is also present, particularly in wet spots along the edge of the woodland. These are associated with red osier dogwood and blackberry, intertwined with greenbrier and wild yam.

On the western side of the strip, within sight of a farmhouse facing Signs Road, are found large stands of red osier dogwood, blackberry, dwarf sumac, elderberry, arrowwood, and pokeweed. Moving on toward Signs Road is a solid stand of gray birch, with scattered bayberry, arrowwood, chokeberry, and cinnamon fern. Overhead one sees sweet gum, white oak, and red maple.

Adjacent to Signs Road red maple is predominant, with scattered black cherry, sweet gum, and sassafras. Under the trees a few elderberry can be found amidst a sea of greenbrier.

The Freeman-Winant Strip (C5-D5)

Traveling southeast from Signs Road along this strip one finds an overhead canopy of red maple, black cherry, sweet gum, ash, and gray birch. Below are dwarf sumac, bayberry and red osier dogwood and a large solid patch of blackberry.

Moving inland, there are scattered remnants of red maple, oak, ash, and a few hawthorns, as well as dwarf sumac, arrowwood, some young staghorn sumac, black chokeberry, and numerous young black cherry. Most of the upper story was destroyed in a recent fire. Many dead specimens remain as mute testimony to this disaster. In one area there is an almost solid stand of wild black cherry, a new growth since the fire. In numerous open grass areas the northern dewberry can be found in abundance, with patches of wild buckwheat. A stand of red maple, pin oak and black cherry grow within sight of Travis Avenue on the north side. Below, in wetter habitats, are found numerous staghorn sumac, young sassafras, and some arrowwood and blueberry. Across, on the south side of Travis Avenue, is an extensive marshy area where poplar, oak, ash, and hawthorn form the upper story. Below, such shrubs

as spicebush, arrowwood, and shrub dogwood predominate, with some elderberry and pokeweed, along with large areas of blackberry, climbing hempweed, Japanese honeysuckle, greenbrier, and bittersweet. On the floor of this swamp land, skunk cabbage grows in abundance.

* * *

Shrubs and vines are useful to wild life of many kinds, affording protection, nesting sites, and food. Vines and shrubs which provide food for birds and other smaller animals at the Refuge are spicebush, blueberry, grape, Japanese honeysuckle, blackberry, dewberry, arrowwood, sumac, elder, Virginia creeper, rose, brier, June berry, dogwood, and witch-hazel.

Many insects are found feeding on the foliage, or seeking pollen and nectar in the flowers. These insects are a ready source of food for birds as well as other small animals. The value of insects as pollinators cannot be viewed lightly because without the hymenopterous and lepidopterous insects, there would be little fruit for the wildlife. These conditions indicate the important interaction between shrubs, vines, birds, mammals, and insects.

As a source of food for humans, many shrubs yield berries and fruits for the table, wines, pies, and jellies. In recent years the recognition of native shrubs and vines as subjects of interest in landscaping has been noticeable. Their beauty of form, flowers, fruit, and their inherent resistance to the ravages of insects and disease enhance their value. The special beauty which autumn brings to our native shrubs and vines is unsurpassed, even by the rarest of our imported materials. Locally, sumac, Virginia creeper, roses, brier, blueberry, viburnum, spicebush, shad bush, witch-hazel, and dogwoods provide the rich red, yellow, and orange typical of our autumn landscape.

LIST OF SHRUBS AND VINES

The plants listed follow nomenclature used in the *New Britton and Brown Illustrated Flora of the Northeastern United States and Adjacent Canada,* by Henry A. Gleason.

**Smilax glauca*	Green greenbrier
**Smilax rotundifolia*	Saw brier
**Dioscorea villosa*	Wild yam
Myrica pennsylvanica	Bayberry
**Polygonum convolvulus*	Wild buckwheat
Lindera benzoin	Spicebush

* Vines or brambles.

Hamamelis virginiana	Witch-hazel
Amelanchier oblongifolia	Shad bush
Aronia melanocarpa	Black fruited chokeberry
Aronia prunifolia	Maroon fruited chokeberry
Rosa setigera	Prairie rose
**Rubus allegheniensis*	Blackberry
**Rubus flagellaris*	Dewberry
Rhus copallina	Dwarf sumac
Rhus glabra	Smooth sumac
**Rhus radicans*	Poison ivy
Rhus typhina	Staghorn sumac
Rhus vernix	Poison sumac
**Celastrus scandens*	Bittersweet
Cornus racemosa	Shrub dogwood
Cornus rugosa	Shrub dogwood
Cornus stolonifera	Red osier dogwood
**Parthenocissus quinquefolia*	Virginia creeper
**Vitis labrusca*	Grape
Kalmia angustifolia	Sheep laurel
Vaccinium corymbosum	Highbush blueberry
**Lonicera japonica*	Japanese honeysuckle
Sambucus canadensis	Elder
Viburnum dentatum	Arrowwood
Viburnum prunifolium	Black Haw
**Mikania scandens*	Climbing hempweed

* Vines or brambles.

Trees

By

EDWIN A. RUNDLETT

TREES PLAY a very important role in any nature study program. Not only are they of great interest in themselves, but they form congregating places for all sorts of animals. They alter, too, all

manner of smaller vegetation about them, changing the nature of the soil, the degree of sunlight, and the moisture available for growth and flower production. The study of ecology—the interrelationship of all these factors and of the resulting plant and animal associations—enables the student to know something of what to expect, and he finds the ways of Nature to be better in many respects than the interfering blunderings of man. He learns to be content with Nature as it is. Staten Island is fortunate in having protected areas of land, such as the William T. Davis Wildlife Refuge, while still being a part of one of the world's greatest cities.

The area included in this survey is shown on map on pages 72-73. The land here is wooded and low, with several springs. Brooks traverse it, flowing out into the salt marshes after passing through cat-tail swamps. Yet there is enough dry land to support a varied growth of many sorts of plants, including trees.

First let us consider the Nature Trail area. A few hundred feet west of Richmond Avenue, an asphalt drive marks the entrance to an old brick building, now used as a Park Department storehouse.(B9-Y3) Near the street entrance to this drive is a gate which is the start of the Nature Trail. Just about here, evidently, there used to be a residence. This we infer from the presence of scattered large silver maples and Carolina poplars. There is also an old apple tree, which might be a seedling of an older tree. On the bank of the nearby brook is a catalpa tree—also evidence of former occupancy of the area by man. Near the brick building another introduced tree is gaining ground, the "tree of heaven" or ailanthus. Westward along the trail is an occasional white mulberry tree, probably the result of seed scattered by the birds. Aside from these, it appears that all the trees "just grew" with little aid from man. No trees in this immediate area are over fifty years old, so farming must have been carried on here before that time.

The dominant trees in the Nature Trail (B9-Y7) area are sweet gum, American elm, red maple, and white ash—all water tolerant species. Less abundant are pin and swamp white oak. Wild black cherry is fairly common, especially along the fence rows on the less moist land. Sassafras trees also prefer the edges of woodlands. Where the shade of taller trees is dense, a few hornbeams and black haw trees may be found. The former is often known as blue beech because of its smooth, blue-gray bark. The bark of the latter looks much like that of the flowering dogwood.

The condition of the elms calls for comment. These are the

oldest trees in this area. At one time they were abundant; however, now there are few survivors and they are in horrible condition. Fire swept through this area many years ago, and severely damaged the bases of these trees. Thereafter they became subject to many types of wood decay fungi, and fell prey to a multitude of boring and leaf-feeding insects. Birds have consequently found an ample supply of food in and around these elms. Spraying in such a marshy area is impractical and certainly undersirable in a wildlife sanctuary. Those trees that are a menace to the trail are being removed. There is no lack of new young elm tree growth that started after the destructive fires.

Out in the swamp, about fifty feet beyond the marked poison sumac shrub, is a lone European alder tree. The few remaining gray birches along the trail are in too much shade to thrive. They are sun-loving trees. One or two native sycamore trees can be spotted by their mottled bark, with their distinctive glistening white areas in the upper parts of the crown. These like moist lands too, and are of interest since they are almost extinct on Staten Island.

Following Travis Avenue westward to the point where Vreeland's Brook passes under it in a culvert,(B0-Y8) we come to the strip of woodland that extends eastward to Signs Road. The east border of this strip is almost impenetrable and too moist under foot for comfort. The dominant trees are again large elms, some of them up to thirty inches in diameter, along with pin oaks of similar size. The elms are in a bad state of decay. Fire was here, too. Along the west border of this same strip of woodland the going is better because drier, and for several hundred feet a dirt road enables one to walk easily. Here the trees are smaller; pin oaks are dominant, but gray birches and wild black cherries are frequent, but fire-scarred. Catbrier patches and swampy spots make detours into the farm land necessary to reach Signs Road. There is a hard-pan of clay close to the surface in this section, and it has resulted in many of the trees of large size being uprooted. They lie where they fell. Young white ash and sour gum or tupelo trees are seen in the swampy area. At Signs Road is a solid stand of red maples, two trembling aspens, and one tulip tree.

As in the case of the land where the Nature Trail is situated, the denser woodland is bordered by a considerable number of sassafras, wild black cherries, and an occasional intruding Asiatic tree, the ailanthus. It is interesting to note how the male trees of this species huddle together like shy youths at some distance from groups of clustered female trees. Try to fathom the reason. It is

easy if one is observant.* Deep within these woods are a few tall sycamores in wet land.

Let us return to Travis Avenue and turn westward past the strip of open farm land to the point where there is a frame building on the right, and an indistinct dirt roadway (B1-Z2) leading off to the left through a patch of tall woodlands. We find these woods are strewn with huge boulders, interspersed with numerous puddles and springs. Farming could not have taken place here. The trees are up to three feet in diameter, mostly elms and pin oaks, with a lesser number of white ash and red maples. Fire naturally did less damage here, and the trees look better for that reason. The tree population is about the same as near the Nature Trail, with no new varieties in evidence. Instead of extending to the marshes on the south, the woods are bordered by open grass land that until recently was farmed, but is now unused in any way. Blackberry growth has taken over—one of the first steps toward reforestation. The grass land is comparatively dry.

One more strip remains to be inspected—the one across Travis Avenue from the above boulder strewn woodland (C1-Z2) extending all the way to Signs Road. It is mostly grass land and quite dry. Tree growth is sparse here, consisting mostly of gray birch and scrubby pin oaks much the worse for fire that started in the grass along the roadsides and swept inland. About half way to Signs Road the character of the trees changes. This may be due to the presence, years ago, of an old home, said to have been the home of the father of Theodore Roosevelt. (See *Proceedings,* Vol. XIX, No. 1, p. 28.) A clump of pear trees and a couple of old apple trees grow near the foundation. Ailanthus are numerous. Many gray birches—one of the first trees to reclaim abandoned farm land —are nearby. About fifteen white mulberry trees growing along the road are probably offspring of an old lawn tree introduced while the house was inhabited. Other scattered trees nearby include white ash, sassafras, swamp white oak, and wild black cherry. The entire strip, from one street to the other, is quite dry, and should support a tree growth of very different character from the other areas mentioned—so long as fires can be prevented. The tall grasses bordering the marsh offer a great hazard.

Following is a list of trees seen in a single day's hike. Some surely were missed, and observers should add them as they find them. A second list includes the sorts of trees one would expect

* If the reader cannot find the answer, we suggest that he communicate with Mr. Rundlett. — Ed.

to find in the area, since they are known to exist not far distant, or once to have existed and to have become almost extinct. It is thrilling to locate a lingering remnant of bygone days. It is well also to consider introducing good types of trees that were once native to Staten Island.

LIST OF TREES

Trees Found in 1956:

Alnus glutinosa	Alder, European
Malus pumila, var.	Apple, seedling
Fraxinus americana	Ash, white
Populus tremuloides	Aspen, quaking
Betula populifolia	Birch, gray
Catalpa speciosa	Catalpa, northern
Prunus serotina	Cherry, wild black
Malus floribunda	Crabapple, flowering
Ulmus americana	Elm, American
Nyassa sylvatica	Gum, sour (Tupelo)
Liquidambar styraciflua	Gum, sweet
Celtis occidentalis	Hackberry
Crataegus sp.	Hawthorne
Carpinus caroliniana	Hornbeam, Carolina
Acer rubrum	Maple, red
Acer saccharinum	Maple, silver
Morus alba	Mulberry, white
Quercus palustris	Oak, pin
Quercus bicolor	Oak, swamp white
Pyrus communis	Pear
Populus nigra x P. canadensis var. *eugenei*	Poplar, Carolina
Sassafras officinale	Sassafras
Platanus occidentalis	Sycamore
Ailanthus altissima	Tree-of-Heaven
Liriodendron tulipifera	Tulip
Salix sp.	Willow

Trees not found in 1956, but which might well be present because of known suitability or evidence of previous existence:

Ash, green	Locust, black
Aspen, large-toothed	Mulberry, black
Basswood	Oak, black
Beech, American	Oak, post
Birch, sweet	Oak, red
Birch, river	Oak, scarlet
Butternut	Oak, scrub
Cedar, white and red	Oak, white

Dogwood, flowering	Orange, osage
Elm, slippery	Persimmon
Hickory, four kinds	Pine, pitch
Holly, American	Pine, Virginia
Hornbeam, hop	Pine, white
	Walnut, black

Thus the numbers of tree varieties found and probable are about equal. This second list is a good one to scan if an attempt should be made to introduce trees that fire has destroyed or which, like the red cedar and the American holly, have been used by men and not replaced.

Some on the above list thrive in moist lands, whereas others do not. A thorough study of soil moisture and plant associations would be desirable before starting a planting program. We should not stop there. As students of nature, we should learn to know fall coloration, bark appearance, and many other facts about each tree before we feel we really know it. The Refuge is a fine place to carry on such a study.

BOOK REVIEWS

TEN THOUSAND YEARS IN AMERICA, by William Smith Fowler. Vantage Press, Inc., New York. 1957. 160 pages. $2.95.

Ten Thousand Years in America is an attractive, well illustrated summary of the various cultural levels of New England Indian life from earliest to historic times. To this Connecticut Yankee with a soft spot for Indian lore it is an exciting and stimulating story.

Much of this little volume is derived from personal observation and research. The author, William Smith Fowler, is a New Englander who has spent a lifetime in the field, collecting, experimenting with and creating a great variety of "primitive" artifacts. He organized the Connecticut Valley Chapter of the Massachusetts Archeological Society and led extensive research excavations of aboriginal soapstone quarries in Massachusetts, Connecticut and Rhode Island.

The discovery of the fluted stone weapon points named Folsom for the type locality opened a new phase of archaeology in this country. Since that time many other similar objects have been found in east and northeast United States, which has made it possible for the author to reconstruct this "Paleo-Indian" culture in New England. These ancient Americans hunted now extinct animals, such as mammoths, during the retreat of the last or Wisconsin ice sheet and under climate conditions much colder than at present. The social unit was a small hunting band which followed its prey as the availability of game and the seasons indicated.

This cultural period lasted until a temporary return of the ice brought conditions incapable of supporting life. As the ice again retreated a new group of hunters appeared and a culture based on the caribou developed. Perhaps the Eskimo of northern Canada today may be the descendants of these old caribou hunters who followed the caribou north with the retreating ice.

The author pays a good deal of attention to the "Stone Bowl Makers," whose remains he has so industriously studied. The material is soapstone and the bowls, trays, spoons and other utensils found in various sites envision a two thousand year period of comparably high level culture. This period is followed by the rise of potters and the story ends with the always sad account of the unequal struggle of the Indians against the "superior" weapons, disease, and vice of the white invader.

What of Staten Island during this long period? Certainly we must have experienced the same climate as the rest of northern United States and we have found remains of mastodons which may have been hunted locally as they were elsewhere.

ROSWELL S. COLES

AMERICAN FERRYBOATS, by John Perry. Wilfred Funk, Inc., New York. 1957. $3.95.

John Perry's *American Ferryboats* opens up a vista into the development of our nation from the days when the Indians transported travelers in canoes, only to be replaced by white men who found the business profitable. Indeed, the ferry was the link whenever our roads met up with streams or lakes of any size before bridges were constructed. Often the ferryman combined his role with that of innkeeper. In this volume are recorded the various craft employed, canoes, periaugers, sloops, current ferries, teamboats, all of which yielded in the end to steam-driven ships, at first usually with paddle-wheels and later propellers.

The reader will find color and adventure in the perilous crossings and mishaps, the ferrying by Brigham Young's Mormons, the forty-niners fighting for places on the ferries in the gold-rush days, fierce litigation and rivalry, and the saga of twenty-two ferries transformed into warships in the Union Navy during the Civil War. Staten Islanders can take pride in the deeds of the *Westfield* and *Clifton*. They left the Staten Island service, the *Westfield* to help Admiral Farragut force the entrance to the Mississippi, only to blow up later at Galveston; the *Clifton* to take part in the same action and finally perish under the fire of Confederate batteries at Sabine Pass in Texas.

Not much, of course, can be told of the Staten Island ferries in a book which is concerned with the whole country, but there are references to that service in early times (p. 40), as well as to the operations of Cornelius Vanderbilt (ch. IX), and the "canonization" of George Law, when the St. George Terminal was named after him (p. 173). Perhaps readers will be impressed by the fact that in the past fifty years the Staten Island ferries have steamed twenty million miles and carried a billion passengers.

Mr. Perry's book is well written and both richly and delightfully illustrated.

KENNETH SCOTT

SEA TREASURE, A GUIDE TO SHELL COLLECTING, by Kathleen Yerger Johnstone. The Riverside Press, Cambridge. 1957. $4.00.

It must be a source of some puzzlement to determine just what really belongs in a natural history handbook or guide. This latest one in the rapidly growing field of shell books, for instance, gives such a generous portion to shells in archaeology, history and literature, that only slightly less than half of an ample bibliography is devoted to items dealing with these subjects, including three texts on heraldry. This is not to be construed as criticism, since Mrs. Johnstone entertains us with many interesting facts which she narrates in a most beguiling manner.

All the basic knowledge necessary to the beginning collector is here told in simple, direct, easily comprehensible language. The best chapters are devoted to the personal experiences of the Johnstones, whose collecting has been so successful that two important east coast mollusk subspecies are named for them. At times the language is almost childishly simple, so that the reader wonders whether the book is directed chiefly to the younger set, but in relating her own collecting experiences and those of friends with whom she corresponds, Mrs. Johnstone's prose is mature, robust and hearty. The warm, vivid word pictures with which the author describes shells will be an endless source of delight to the true shell lover and every amateur of sympathetic writing. Eight superb color plates by Rudolph Freund and René Martin, as well as numerous page cuts, add much to the extreme attractiveness of the book. The nomenclature of the small number of shells mentioned is completely up to date, and Mrs. Johnstone is to be commended for disregarding the plethora of "genera" that appeared in a recent popular work on the cowry shells of the world and boldly sticking to the true name, *Cypraea.*

The errors are trivial for the most part. "Cañón del Muerto" means Dead Man Canyon, not Canyon of Death (p. 172); the address of the American Museum of Natural History is New York 24, not 4 (p. 23); resilium and internal ligament of pelecypods are not identical (p. 13); the definition of genotype on page 56 is erroneous. Somewhat more serious is the suggestion that muriatic acid be used in cleaning shells. This is fatal, because the hairlike structures of many protoconchs as well as other delicate shell sculptures, which are frequently of great diagnostic value, are always destroyed. There is a lively chapter called "Don't Be a Pig," which vigorously urges conservation while out shell hunting. But strangely enough, no reference is made to the most serious of crimes committed by the thoughtless collector: namely, the failure to replace turned over rocks and coral boulders.

But all this does not detract seriously from the value of a very able, attractive book which radiates such true enthusiasm that it is bound to infect seriously even the casual browser.

MORRIS K. JACOBSON

SNAKES AND SNAKE HUNTING, by Carl Kauffeld.* Hanover House, New York. 1957. 266 pages. $3.95.

The nostalgia with which Mr. Kauffeld relates his snake hunting experiences brings to mind the spirit which prevails at reunions of old schoolmates or army buddies. In retrospect, interesting or exciting episodes

emerge with such enhanced glamour that memory of the less pleasant components is overwhelmed.

Naturalists, who, in common with Mr. Kauffeld, have experienced the rewards of field work, will simultaneously vicariously enjoy his adventures and follow their own private paths of recollection.

The biologist reading this book might overlook the dogmatic way in which hypothesis is worded in a number of passages if it were not for the fact that Kauffeld the naturalist is identical with Kauffeld the herpetologist. Those naturalists who lack the biological sophistication necessary to critically evaluate these passages are, at times, in danger of confusing pure speculation with speculation substantially reinforced with data.

The duality of the author is occasionally demonstrated also when Kauffeld-naturalist pushes Kauffeld-herpetologist toward the brink of the teleological pit. Fortunately, the push is usually not quite hard enough.

The last chapter, *A Plea for Snake Conservation,* presents a point which is of interest to all naturalists. The author proposes a "Holbrook Society," perhaps patterned after the Audubon Society, which would function chiefly through concerted effort to make apparent to the public the need for snake conservation, and to advocate the extension and enforcement of laws such as those which protect the alligator, diamondback terrapin, Gila monster, and horned toad.

On the whole this volume will provide an evening of enjoyable reading to those who have any interest in natural history.

ALLEN WACHTEL

MICE AT HOME AND AFIELD, by Olive L. Earle.* Illustrated by the author. William Morrow & Co., Inc., New York. 1957. $2.25.

"Countless numbers of true mice and mouse-like rodents live on this earth. They live, too, in literature—from the earliest fables to the present-day stories about Mickey Mouse."

And so Miss Earle has done much in her book on *Mice at Home and Afield* to capture an interest in these little animals that are so disliked and so feared by so many people. They are thieves—as she explains, the name mouse comes from an ancient Asiatic word meaning thief. Miss Earle tells about the many varieties of mice, their habitats and their food. The harvest mouse, the deer mouse, the tree mouse and others are so vividly described that we feel we could readily recognize each variety. Their different nesting habits and the great number of babies produced during their short life span explains why we have so many of them around. Their structure, the use of their long tails and their clever ways of eluding their enemies is very interestingly told.

This little book is artistically illustrated and, with the clever description of each mouse specie, creates an interest in this little creature that is such a destructive yet interesting member of the animal kingdom. This, like all of Miss Earle's books for children, would be a valuable asset on "Young Reader's Shelves."

MARION E. MERRICK

* Staten Island resident.

THE GREAT CHAIN OF LIFE, by Joseph Wood Krutch. Illustrated by Paul Landacre. Houghton Mifflin Company, Boston. 1957. $3.75.

It is an astonishing fact—perhaps the most astonishing of all facts, says Joseph Wood Krutch in *The Great Chain of Life*—that "after this earth had existed for billions of years there finally appeared upon it a creature" capable of reaching back through those billions of years to trace his own origins and form "what he believes to be more or less correct opinions concerning what happened so long ago."

The words "more or less correct opinions" are the underlying theme, one might say, of this important book. "In science no less than in religion honest doubt is worthy of respect and it is for honest doubts that I plead," are the author's words. Dr. Krutch is a scholar and a thinker, a man who loves the world and its creatures, a poet and a humanist. The role he has chosen as the author of *The Great Chain of Life* is that of the intelligent layman whose joy for the living leads him to question profoundly the scientists who would define the world in terms of the purely material.

As Dr. Krutch points out, the man who once said, "I am a materialist because everything is ultimately material," could easily define what he meant by matter—that which occupies space and has weight. Therefore, to say "I am a materialist" meant "I believe that the only fundamental reality is that which occupies space and has weight." But, the "Matter that disintegrated privately over the American desert and then publicly over Japan ceased in those instants to occupy space." The materialist, too, then ceased to have a definable stand.

The beginnings of a new approach to the study of life by the scientists, and the beginnings of a new effect of their studies on animalkind, including man, are a part of the scope of this book. Biologists can no longer ignore consciousness—the emotional awareness of living things. To be alive is exceptional in itself. To be "capable of ingenuity and joy; of achieving beauty and of demonstrating affection"—it is these wonders that Dr. Krutch celebrates.

There is a word, "anthropomorphism," which is used, often with contempt, by scientists to define the attitude that attributes man-like personalities and emotions to non-human animals. Dr. Krutch holds up the word invented by Konrad Lorenz, "mechanomorphism," and warns that this, the "stubborn determination to see everything in terms of the machine," or the laboratory, may be a fallacy just as serious. Basically, the book comes back to this theme again and again, while ranging through such varied observations as a charming vignette of the handsome little organism, Volvox, a thrilling essay on "The Meaning of Awareness," or a serious contemplation of Darwin and his successors.

This is a thinking book, a speaking book, that demands a thinking reader. It is richly rewarding. The author's comments on many subjects are provocative and well expressed. A chapter on "Reverence for Life," subtitled "The Vandal and the Sportsman," is alone worth the price of the book.

CARLIN E. GASTEYER

IN THE SPIRIT OF CHALLENGE, Essays by Richmond E. Lawlor.* Exposition Press, New York. 1957. $3.00.

This book is a challenge to forsake faith in material progress and awaken to spiritual values. At first glance, the four essays appear to be on widely differing subjects, but they are unified by the central theme of freedom—freedom often accompanied by loneliness. Thoreau, in the first essay, represents the individual, free American; "The Truculent Village" believes that it is free; the essay on Chirico portrays freedom in art; the final essay, "Freedom and Survival," considers "freedom" and "spirit" as synonymous terms and points to a freedom to be attained by spiritual evolution. In all four essays, the style of writing is uneven—sometimes involved and obscure, sometimes graceful, firm, and lucid. Fundamentally serious in tone and purpose, the book is not without a tart and tantalizing humor.

When dealing with Thoreau, the author writes with insight: "Those who call him narrow are not in error; his growth followed that of the trees in his own Walden woods; he could get very high aloft and enjoy a true perspective, while sending roots to search for the springs that fed Walden. . . . But within him the secluded cabin, the wild things, the bottomless pond of miraculous source, remained through all vicissitudes, lonelier than Walden or remoter places, and inaccessible as these never were." When, in the same essay, Mr. Lawlor treats of Emerson, he is less happy. Some readers will find it difficult to agree that there is a "flabbiness" somewhere in the structure of Emerson's thought and that he "forecasts high-pressure salesmanship and American Babbitry."

If the reader is one whose memory goes back to trolley cars with swinging poles, to violets among the sweet rushes below old St. Andrew's, to apple trees in blossom on the hillside, and to willow-bordered creeks meandering across the meadows, he will smile as he turns the pages of "The Truculent Village," and he will read on with a delighted sense of experiencing something like a resurrection of his own childhood. If he likes modern art—or if he is trying to understand it—he will find satisfaction in the illuminating essay on the modern artist, Giorgio de Chirico. Here loneliness overshadows freedom. The pleasing loneliness of Claude Lorraine, of Turner and El Greco and Corot leads up to the awful loneliness of Chirico, the "desolate, comfortless estrangement" of "man who has built a world he cannot live in, and isolated himself from Nature and his Creator." The last two paragraphs of this essay represent Mr. Lawlor's style at its best.

The final essay, "Freedom and Survival," emphasizes the need for the rebirth of the human spirit. "Read the papers and you get an impression of universal lawlessness, especially among the young. What seems to be needed is more law, more order, more policemen. What really is needed is a goal: some new and fresh departure from political rubber stamps, scientific dicta, religious dogmas. . . ." For the achievement of this goal, Mr. Lawlor offers an attitude rather than a program. "I will not have my curiosity circumscribed," he says. "Authoritarian pedants will say that this or that matter is settled and further speculation is futile, but human progress has been marked by the unsettling of settled matters. . . . If my curiosity transcends

* Staten Island resident.

the possible and the physical, I do not feel the need to apologize. If science is satisfied to bound its activities at the frontiers of the spiritual, I want to suggest that it is destined to overstep these barriers, because it has outgrown them."

The need of the human spirit to free itself from pronouncements, not only of the sciences—biology, physics, psychology—but also of organized religion, politics, business, and scholarship, when these pronouncements are limiting and final—this is the kind of freedom with which the fourth essay is chiefly concerned. In it the author dedicates himself to "the exploration of the unprobed reaches of the human spirit," a goal which "has nothing to do with cults, and is quite as legitimate as a curiosity about space-navigating or nuclear physics."

The book-jacket is right. *In the Spirit of Challenge* will "disturb some and perhaps anger others," but it is, on the whole, a stimulating little book—one which should not be overlooked by thoughtful readers.

IDA G. EVERSON

CITY IN THE SAND, by Mary Chubb. Illustrated with photographs and a map. Thomas Y. Crowell Company, New York. 1957. $3.95.

" 'One Siffle is Dinnertimes
Two Siffles is Man-on-Sea!
Three Siffles is Jump Ship!' "

What a wonderful beginning for a book of scholarly adventure! The sign, translated from Rumanian for the benefit of English passengers on the boat, introduces the reader to a pleasant interlude in Greece, which is later followed by the excavations of Eshumna at Tell Asmar in Mesopotamia.

Returning to London after working as secretary to the dig at Tell El Amarna in Egypt (described earlier in *Nefertiti Lived Here*), Miss Chubb faced the prospect of drab secretarial work in a wholesale business, when suddenly she found a new adventure.

Step by step she takes us into her world of archaeological specialists (a gay, earnest, brilliant group)—of the desert sands of Mesopotamia today and of the city of Eshumna some 4,000 years ago. She enlightens us, also, as she learns herself. As she is led back into the civilizations in the ancient land of Sumer and Akkad she takes us with her—by the explanations of her expert team-mates, by facts from her reading, by the descriptions of the actual dig.

The peculiar charm of the book lies in Miss Chubb's personal approach. She looks on life with enthusiasm and understanding. Any experience described by her would surely be interesting, but the remarkable thing is that everything she has lived through is most unlikely to happen to most people. If you have never dug up a lost city, this is the book for you.

ELIZABETH CONGER

THE HIGHEST DREAM, by Phyllis A. Whitney.* David McKay Company, Inc., New York. 1956. 240 pages. $3.00.

Phyllis A. Whitney has written another novel to delight the teen-age girl. *The Highest Dream* tells of the life and problems of a young girl who works as a tour guide at the United Nations.

Using the U.N. as a background, the author weaves the different departments of that great organization in and out of her novel. Her descriptions are graphic and always lit with a sympathetic understanding of the great purpose of the U.N. The title of the book is taken from a quotation of Thomas Curtis Clark: "Let us no more be true to boasted race or clan, But to our highest dream, the brotherhood of man."

Lisa Somers, the heroine, although at times a shadowy character, is on the whole believable. After being graduated from college she leaves her home in Washington, D. C., to come to New York, hoping to escape from the shadow of her father's fame as a radio commentator and her mother's charm and ability. Lisa's roommate in their little New York apartment is the perfect foil for the heroine. Margie, an extrovert, knows what she wants and usually gets it. After successfully trapping the man of her choice, a U.N. engineer, she bends her efforts, not too subtly, toward snagging his friend for Lisa. Lisa rebuffs her firmly and, after some gentle agonizing, gets her man in her own way.

If *The Highest Dream* becomes popular across the country—as it well may—the U.N. no doubt will be deluged with applications from young ladies seeking to become tour guides.

MARIE B. SUTTER

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* Staten Island resident.

HOW TO MAKE CUT FLOWERS LAST, by Victoria R. Kasperski. M. Barrows and Company, New York. 1957. $2.95.

Writing a book review can be a tedious task or a real pleasure, depending upon the quality of the book. Victoria Kasperski's *How to Make Cut Flowers Last* left in this reader a keen desire to share his enthusiasm with as many Staten Islanders as possible.

The author seems exceptionally well qualified to write on this subject. After a basic education in the Pennsylvania School of Horticulture, she has been for six years the professional flower arranger for the Mount Vernon home of General Washington. In addition, she lectures for the National Council of State Garden Clubs, and conducts classes in arranging.

The book begins with a discussion of the principles of preventing wilting. Special pointers are given for the cutting and care of different types of blooms and plant materials. Here are some headings: flowers for shows; church displays; corsages; woody-stemmed flowers; bulbs. Refrigeration, transportation, and the use of chemicals are all covered in a pleasing manner.

The main body of the book, alphabetically arranged and using both English and Latin names, gives concise directions for the cutting, condi-

tioning, and care of 300 flower and foliage types. It tells how long each one can be expected to last, and cautions the collector against injury to the remaining plant.

A final chapter gives information on dried bouquets, dyeing, and pressing. Sources of artificial aids are given. The bibliography attests to the dependability of the advice provided.

EDWIN RUNDLETT

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of the

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Volume XX
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Fall 1957

PROCEEDINGS OF THE STATEN ISLAND INSTITUTE OF ARTS AND SCIENCES

Mildred S. Powell, ***Editor***

James L. Whitehead, ***Director and Editor of Publications***

Volume XX

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PROCEEDINGS OF THE STATEN ISLAND INSTITUTE OF ARTS AND SCIENCES, Vol. XX, No. 1, Fall 1957. Published semi-annually in spring and fall by the Staten Island Institute of Arts and Sciences, 75 Stuyvesant Place, Staten Island 1, N. Y. Single copies seventy-five cents. Sent free to Museum members. Mildred S. Powell, Editor.

THE

WILLIAM T. DAVIS WILDLIFE REFUGE

(continued)

The following articles on the Refuge conclude the series which began in the Fall 1956 Proceedings and was continued in the Spring 1957 Proceedings. The former articles dealt with the history of the Refuge and the botanical aspects of the area. The articles in this issue deal with its zoology.

We repeat on pages 24 and 25 the map drawn by I. C. G. Cooper to aid in understanding the survey. Co-ordinates are furnished where necessary in the articles. (By Mr. Cooper's sudden death on September 29, 1957, we were deprived of one of our most esteemed members.)

We reiterate our thanks to Olive L. Earle for the art work throughout the series.

Mr. Robert Mathewson has acted as guest editor.

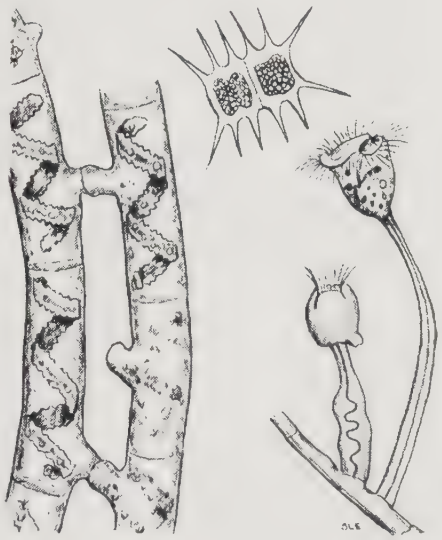
Microscopic Life

By

I. C. G. COOPER

PART I—ALGAE—published in the Spring 1957 *Proceedings*

PART II—PROTOZOA



PART II—PROTOZOA

PROTOZOA are generally described as unicellular animals. The majority are microscopic and associated with other animals and plants, but there are a large number of free living forms. These free living invertebrates can be found under various conditions in the Refuge. This population has probably suffered depletion due

to the effects of pollution floating in from the garbage fill operation, oil slicks, and spraying for mosquito control.

In making studies of the invertebrates, immediate examination of water collections must be made, and also cultures must be maintained to determine species which may have been collected in resting stages. Collections have consisted of water samples containing scums, plant stems, and mosses and soil dug from the bottom and sides of pools. It has been found that the nutrient fluids used in algal cultures are also helpful in protozoa studies. Soil samples have been placed in the solutions and in distilled water. After varying periods the protozoa may be found as swimmers, on algae growing in the water, or on the side of a container, or near the surface of the immersed soil.

This study has been in operation for about one year. It should be regarded as a preliminary report. In only a few instances has it been possible to identify the protozoa found by species as well as by generic name. We are indebted to Mr. A. M. Calpini, who has spent many hours at the microscope searching out the forms recorded. It is hoped to continue and broaden the scope of this study.

LIST OF PROTOZOA

Actinophrys sol
Apostomea
Aspidisca
Arcella vulgaris
Amphisiella
Amoeba
Centropyxis aculeata
Colpoda
Colpidium
Dileptus
Euglena acus
Euglena deses
Euglena elastica
Halteria
Loxophyllum
Lacrymaria olor
Oxytricha
Paramecium caudatum
Paramecium aurelia
Podophrya
Spirostomum
Stylonchia putrina
Stentor
Trachelomonas
Urocentrum
Uroleptus
Vorticella

Descriptions of the protozoa listed above may be found in *Protozoology* by Richard R. Kudo, D.Sc., and Charles C. Thomas.

Specimens referrable to the following life forms have also been observed:

Cyclops
Foraminifera
Gastrotricha
Lumbricus
Ostracoda
Planaria
Rotifer

Insects

By

WILLIAM H. LOERY

STATEN ISLAND has been a source of much interest to students of the insect life of New York State. This interest is due in part to our position in the extreme southern portion of the state where migrant species from the south are first apt to appear. It is also due to the provision of productive and convenient collecting grounds for the many entomologists, both amateur and professional, who are required to wrest a living from New York City. Some of these men have lived on Staten Island, while others have paid frequent visits during leisure hours. Hence entomologists such as Howard Notman, John D. Sherman, Jr., Alan S. Nicolay, Ernest Shoemaker, Louis H. Joutel, Martin L. Linell, Charles W. Leng, and William T. Davis have been closely associated with the development of Staten Island entomology.

As a result of the intensive field work carried out by these and many other workers, the insect fauna of Staten Island is relatively well known. Our insect population is changing, however, with the rapid urbanization of Staten Island. Continued field work is necessary if we are to appreciate this change. It is for this reason that a survey of a portion of the insect fauna of the William T. Davis Wildlife Refuge is being conducted. The present paper is only an interim report. A thorough survey of all the insect orders would require the combined efforts of many workers. Discussion in this paper is limited, therefore, to the Coleoptera or beetles, the largest insect order and the order which has received considerable attention from previous workers.

Fauna is dependent on flora. Nowhere is the dependence or interdependence of plant and animal life more beautifully portrayed than in the relationships of insects to plants. Insects are a highly mobile and adaptive group which are unsurpassed in their ability to occupy a variety of environmental niches. This aggressive behavior has brought them into close contact with the plants and other animals in their environment. Only the sea and salt marsh are uncongenial habitats for all but a few insect species. These relationships are well illustrated by the insects at the Wildlife Refuge.

At present, the area of the Refuge includes five main types of habitat: farm land, abandoned farm land, second-growth woodland, and salt and freshwater marsh. There are several small freshwater streams flowing into the strongly brackish water of Main Creek, and one small stand of fresh water. As a result, most of the water beetles and the leaf-eating beetles which feed on water plants are not common at the Refuge. The insect life of these different habitats will be considered separately.

Farm land under active cultivation is not included within the boundaries of the Refuge, but abuts directly on it. The fields are given over to truck farming and the principal crops are tomatoes, lettuce, carrots, and several other leafy vegetables. The gardening has attracted numerous species of leaf-beetles (*Chrysomelidae*) to the area. These are generally small, short-bodied and brightly colored insects which are diurnal and readily observed on the leaves of the host crop. Their larvae are plump and sluggish and pupate in the soil. Many of the economically important species limit their feeding to one or several related types of crops. The spotted and banded asparagus beetles are common about the Refuge but occur only on asparagus plants. They are both introductions from Europe. Several species of flea-beetle, so called because of their leaping ability, have been common on spinach during the past year. The Colorado potato beetle, a destructive member of the leaf-beetle family, occurs on Staten Island but has not been observed in the Refuge area during the period of the survey. Truck gardens of the New Springville area are generally well managed and no serious damage to crops by insect pests has been noted. Aiding in crop pest control are the lady-beetles (*Coccinellidae*). Members of this family are probably the only beetles which have been gathered and utilized commercially for the large scale control of insect crop pests. Eleven species have been found

in the Refuge feeding on aphids and other soft-bodied insects. After the harvesting of a crop, field hands leave packing boxes strewn about the field edges. Many black or iridescent ground beetles (*Carabidae*) congregate in the moist earth under these boxes to feed on the small animal life or on the seeds of grasses. Also found in this area is one of the two species of tiger beetles found at the Refuge. Eleven species of these highly active, predatory beetles (*Cicindelidae*) have been recorded from Staten Island but several have since become locally extinct. *Cicindela punctulata,* a black species with indistinct white dots, inhabits the open fields and gardens, whereas *C. sexguttata,* a brilliant green form, is found along woodland paths.

The abandoned farm land at the Refuge is particularly rich in insect life. Botanical succession is rapid in this environment and the insect census closely reflects changes in the flora. Flowering herbaceous plants including milkweed, Queen Anne's lace and goldenrod each have their peculiar insect consorts. Those of the common milkweed are among the most conspicuous and, peculiarly, almost all have red or orange and black as their dominant colors. The monarch butterfly, the long-horn beetles *Tetraopes tetrophthalmus* and *T. melanurus,* the chrysomelid beetle *Labioderma clivicollis,* and the hemipteron, *Lygaeus kalmii,* are all confirmed followers of the milkweed and all show this similarity of coloring in the adult stage. The milkweed beetle, *Tetraopes,* is one of our most readily observed insects at the Refuge. Its close relative *T. melanurus* is much less common and is distinguished by its smaller size and heart-shaped black marking on the elytra (wing cases). These beetles spend their entire lives in close association with milkweed, the larvae feeding on the roots and larger stems, while adults cling to the flower heads. Even ragweed, which is prevalent along Signs Road and elsewhere despite attempts at eradication, has its complement of beetles. Two ragweed feeders found in the Refuge are longhorn beetles (*Cerambycidae*), whose larvae bore in ragweed stems. One, *Dectes spinosus,* is clothed in uniform gray pubescence and is common. The other, *Hippopsis lemniscata,* is one of our most elongate beetles and is not common on Staten Island. Leng and Davis, in their "List of the Coleoptera of Staten Island," give only one record for this species—a specimen found by Edward J. Burns in 1919.

The woodland portion of the Refuge is very largely a hardwood growth, so that insects living on or about coniferous trees

are scarce. Elm and sweet gum have been the dominant trees in this association. With the introduction of the Dutch elm disease approximately twenty-five years ago, many of the elms began to deteriorate and their dead trunks are particularly prominent today in the area along Vreeland's Brook. The decaying elm wood contains many species of beetles. Some appear to be feeding on the dead wood itself, while others are preying on the wood feeders. Several examinations of these dead trunks during the past year have shown various species of click beetles (*Elateridae*) to be particularly prevalent. One of the most readily identified of these beetles is the eyed elator, *Alaus oculatus*, which is among our largest beetles and is characterized by two large, black "eye spots" on the thorax. The larvae are large "wireworms" and were formerly thought to feed on decaying wood. It has since been determined, however, that they are voracious feeders on other wood boring larvae. Several apparently recently matured adults were taken in mid-April of last year along Vreeland's Brook.

Because the Dutch elm disease has played so important a role in the Refuge woodland, some mention of its biology is appropriate here. The Dutch elm disease is spread largely by two small beetles of the family *Scolytidae*, which includes some of the most destructive forest insects in the United States. Both of these beetles range about 3 mm. in length. One is a native species and the other and more important species was introduced from Europe some time prior to 1909. The two species (*Scolytus multistriatus* and *Hylurgopinus rufipes*) are readily distinguished from each other, not only by structural characteristics but by the character of their burrows in the tree. The elongate, comb-like tunnels of *Scolytid* beetles are often seen engraved in the surface of dead tree limbs after the bark has been removed. The native beetle excavates an enlarged chamber from which two egg galleries extend at widely divergent angles. The European beetle constructs a simple unforked egg gallery. Neither of these beetles successfully attacks healthy intact trees, but must depend on broken or dying wood to gain entrance. The Dutch elm disease is caused by a fungus whose spores are carried from diseased trees to healthy trees by the beetles. The fungus was introduced from Europe some thirty years after the introduction of the European beetle vector. The invasive properties of the fungus itself are low and it would be a relatively unimportant disease if it lacked the beetle vectors. Both species of beetle can exist without the fungus, but the destructive activity of

the fungus provides ever increasing amounts of dying wood in which the insects find favorable breeding conditions. The fungus lives in the cells of the sapwood and readily extends into the beetle galleries where spores are produced in abundance. On emerging from the bark, the beetles are heavily seeded with spores. Important in the natural history of the disease is the characteristic of most *Scolytid* beetles of proceeding directly from old burrows to a new susceptible host and spending a minimum of time in free flight. Control of the disease depends on the removal of beetle infested and devitalized elm wood, supplemented by DDT spraying of individual trees.

Characteristic also of the damp wooded areas of the Refuge are members of the large family of ground beetles (*Carabidae*). These are generally predaceous species which play an important part in the control of injurious insects. Approximately 235 species have been reported from Staten Island, and a good proportion of this number may be assumed to occur at the Refuge. A review of the "List of Coleoptera of Staten Island" issued in 1924 provides several interesting comparisons with regard to this family. *Sphaeroderus lecontei,* a small violaceous member of the tribe Cychrini, was reported as "very rare" on Staten Island, but is not uncommon in the Refuge at present. Members of this tribe are usually found under logs or in leaf mold, and show modifications of the head and mouth parts to facilitate the removal of their principal food, land snails, from their shells. *Carabus vinctus,* a large black Carabid, was described as "a common species" in 1924. Only one specimen was discovered during the course of this survey and the species is believed to be scarce everywhere on Staten Island today. One species of Carabid, *Oodes americanus,* was taken in the bird feeding area (B8-Y7) and constitutes a new record for Staten Island.

The salt marsh area harbors relatively few beetles and other insects. A few unimportant plant feeders prefer palustral plants, however. Several species of tiger beetles inhabit salt beaches, but require a sandy soil rather than the muddy substrate of our salt marsh.

Approximately 2000 species of beetles have been recorded from Staten Island, and the total number of all insect species is, of course, much higher. A list of the species of Coleoptera collected at the Wildlife Refuge during the course of the present survey is appended to this paper.

LIST OF COLEOPTERA

FAMILY	
Cicindelidae:	*Cicindela sexguttata* Fab.
	Cicindela punctulata Oliv.
Carabidae:	*Sphaeroderus lecontei* Dej.
	Carabus serratus Say
	Carabus limbatus Say
	Carabus vinctus Web.
	Carabus nemoralis Mull.
	Scarites subterraneus Fab.
	Bembidion quadrimaculatum (Linn.)
	Tachymenis flavicauda (Say)
	Amara cupreolata impuncticollis Say
	Triaena angustata (Say)
	Dicaelus elongatus Bon.
	Platynus sinuatus (Dej.)
	Platynus reflexus Lec.
	Platynus extensicollis (Say)
	Platynus ferreus (Hald.)
	Platynus placidus (Say)
	Galerita janus Fab.
	Galerita bicolor Dru.
	Lebia atriventris Say
	Pinacodera limbata (Dej.)
	Chlaenius aestivus Say
	Chlaenius laticollis Say
	Chlaenius sericeus Forst.
	Oodes americanus Dej.
	Harpalus caliginosus (Fab.)
	Harpalus pennsylvanicus DeGeer.
	Anadaptus baltimorensis (Say)
	Agonoderus pallipes (Fab.)
Dytiscidae:	*Hydroporus undulatus* Say
Gyrinidae:	*Dineutes emarginatus* Say
Hydrophilidae:	*Tropisternus lateralis* (Fab.)
	Sphaeridium scarabaeoides (Linn.)
	Cercyon praetextatus (Say)
Silphidae:	*Silpha noveboracensis* Forst.
	Silpha americana Linn.
	Choleva terminans (Lec.)
	Prionochaeta opaca (Say)

Staphylinidae:	*Philonthus cyanipennis* (Fab.)
	Staphylinus tomentosus Grav.
	Staphylinus cinnamopterus Grav.
	Staphylinus maculosus Grav.
	Staphylinus fossator Grav.
	Creophilus villosus (Grav.)
	Tachinus flavipennis Dej.
	Erchomus ventriculus (Say)
Histeridae:	*Hololepta aequalis* Say
	Hister bimaculatus Linn.
	Platysoma depressum Lec.
	Paromalus aequalis Say
	Saprinus pennsylvanicus Payk.
	Saprinus assimilis Payk.
Lycidae:	*Calopteron terminale* (Say)
	Calopteron reticulatum (Fab.)
Lampyridae:	*Lucidota corrusca* (Linn.)
	Photinus scintillans (Say)
	Photuris pennsylvanica (DeG.)
Cantharidae:	*Chauliognathus pennsylvanicus* DeG.
	Chauliognathus marginatus Fab.
	Podabrus rugulosus Lec.
	Cantharis carolinus Fab.
	Cantharis bilineatus Say
Melyridae:	*Collops nigriceps* (Say)
Cleridae:	*Enoclerus nigrifrons* Say
	Hydnocera humeralis Say
	Hydnocera pallipennis Say
Cephaloidae:	*Cephaloon lepturides* Newn.
Mordellidae:	*Tomoxia lineella* Lec.
	Mordella octopunctata Fab.
	Mordellistena comata (Lec.)
Rhipiphoridae:	*Macrosiagon limbatum* (Fab.)
Meloidae:	*Epicauta pennsylvanica* (DeG.)
	Epicauta cinerea (Forst.)
Pyrochroidae:	*Dendroides bicolor* Newn.
Elateridae:	*Adelocera discoidea* (Web.)
	Alaus oculatus (Linn.)
	Limonius griseus Beauv.
	Monocrepidius bellus (Say)
	Ctenicera aethiops Hbst.

Elateridae: (*Continued*)	*Hemicrepidius memnonius* (Hbst.)
	Ampedus nigricollis (Hbst.)
	Ampedus sayi (Lec.)
	Melanotus communis (Gyll.)
	Melanotus fissilis (Say)
Buprestidae:	*Acmaeodera tubulus* (Fab.)
	Anthaxia quercata (Fab.)
	Chrysobothris femorata (Oliv.)
	Agrilus bilineatus (Web.)
	Agrilus anxius Gory.
	Agrilus ruficollis (Fab.)
	Agrilus egenus Gory.
Heteroceridae:	*Heterocerus undatus* Melsh.
Dermestidae:	*Dermestes caninus* Germ.
	Dermestes vulpinus Fab.
	Dermestes frischi Kug.
	Dermestes cadaverinus Fab.
	Anthrenus verbasci (Linn.)
	Anthrenus scrophulariae (Linn.)
Ostomidae:	*Tenebroides bimaculatus* (Melsh.)
	Tenebroides corticalis (Melsh.)
Nitidulidae:	*Boreades abdominalis* (Er.)
	Conotelus obscurus Er.
	Carpophilus melanopterus Er.
	Carpophilus niger (Say)
	Omosita colon (Linn.)
	Stelidota geminata (Say)
	Prometopia sexmaculata (Say)
	Lobiopa undulata (Say)
	Phenolia grossa (Fab.)
	Amphicrossus ciliatus (Oliv.)
	Cryptarcha ampla Er.
	Glischrochilus obtusus (Say)
	Glischrochilus fasciatus (Oliv.)
	Glischrochilus sanguinolentus (Oliv.)
Cucujidae:	*Oryzaephilus surinamensis* (Linn.)
	Cucujus clavipes Fab.
	Laemophloeus biguttatus Say
	Laemophloeus liquidus Casey
	Brontes debilis Lec.
Erotylidae:	*Languria angustata* (Beauv.)
	Acropteroxys gracilis Newn.
	Tritoma biguttata Say
	Triplax flavicollis Lec.
	Triplax thoracica Say

Cryptophagidae:	*Antherophagus ochraceus* Melsh.
Mycetophagidae:	*Mycetophagus punctatus* Say
	Mycetophagus flexuosus Say
Colydiidae:	*Colydium lineola* Say
	Bothrideres geminatus (Say)
	Philothermus glabriculus Lec.
Endomychidae:	*Endomychus biguttatus* Say
Coccinellidae:	*Brachyacantha ursina* (Fab.)
	Brachyacantha decempustulata Melsh.
	Ceratomegilla fuscilabris (Muls.)
	Hippodamia tredecimpunctata (Linn.)
	Hippodamia parenthesis (Say)
	Hippodamia convergens Guer.
	Coccinella trifasciata Linn.
	Coccinella novemnotata Hbst.
	Coccinella transversoguttata Fald.
	Neoharmonia venusta (Melsh.)
	Cycloneda munda (Say)
	Adalia bipunctata (Linn.)
	Anatis quindecimpunctata (Oliv.)
	Neomysia pullata (Say)
	Epilachna borealis (Fab.)
Alleculidae:	*Isomira sericea* (Say)
Tenebrionidae:	*Diaperis maculata* Oliv.
	Hoplocephala bicornis (Fab.)
	Platydema excavatum (Say)
	Platydema ruficorne Sturm.
	Uloma impressa Melsh.
	Eutochia picea (Melsh.)
	Scotobates calcaratus (Fab.)
	Xylopinus saperdioides (Oliv.)
	Xylopinus saperdioides rufipes (Say)
	Alobates pennsylvanica (DeG.)
	Tenebrio picipes Hbst.
	Tarpela micans (Fab.)
	Strongylium tenuicolle Say
Melandryidae:	*Melandrya striata* Say
Anobiidae:	*Trypopitys sericeus* (Say)
Bostrichidae:	*Xylobiops basillare* (Say)
	Stephanopachys cribratus Lec.

Scarabaeidae:	*Copris minutus* (Drury)
	Phanaeus vindex MacL.
	Onthophagus hecate Panz.
	Onthophagus janus striatulus Beauv.
	Onthophagus pennsylvanicus Har.
	Aphodius fimetarius (Linn.)
	Aphodius erraticus (Linn.)
	Aphodius haemorrhoidalis (Linn.)
	Aphodius granarius (Linn.)
	Aphodius distinctus (Mull.)
	Ataenius imbricatus (Melsh.)
	Trox erinaceus Lec.
	Trox capillaris Say
	Trox unistriatus Beauv.
	Serica sericea (Ill.)
	Phyllophaga futilis Lec.
	Phyllophaga crenulata (Froel.)
	Macrodactylus subspinosus (Fab.)
	Anomala orientalis Waterh.
	Popilla japonica Newn.
	Pachystethus lucicola (Fab.)
	Pelidnota punctata (Linn.)
	Cotalpa lanigera (Linn.)
	Ochrosidia villosa (Burm.)
	Ligyrodes relictus (Say)
	Cotinus nitida (Linn.)
	Trichiotinus piger (Fab.)
	Trichiotinus affinis (G. & P.)
Lucanidae:	*Pseudolucanus capreolus* (Linn.)
Passalidae:	*Popilius disjunctus* Ill.
Cerambycidae:	*Parandra brunnea* (Fab.)
	Prionus laticollis (Drury)
	Elaphidion mucronatum (Say)
	Gaurotes cyanipennis (Say)
	Anoplodera rubrica (Say)
	Anoplodera pubera (Say)
	Anoplodera vittata (Swed.)
	Anoplodera mutabilis (Newn.)
	Typocerus velutinus (Oliv.)
	Parallelina nana var. *haematites* (Newn.)
	Strangalia famelica (Newn.)
	Strangalia luteicornis (Fab.)
	Phymatodes testaceus var. *variabilis* (Linn.)
	Megacyllene robiniae (Forst.)
	Xylotrechus colonus (Fab.)

Cerambycidae: (*Continued*)	*Neoclytus acuminatus* (Fab.)
	Euderces picipes (Fab.)
	Batyleoma suturale (Say)
	Psenocerus supernotatus (Say)
	Astylopsis sexguttata (Say)
	Urographis fasciata (DeG.)
	Dectes spinosus (Say)
	Hippopsis lemniscata (Fab.)
	Oberea ocellata Hald.
	Tetraopes melanurus Schon.
	Tetraopes tetrophthalmus (Forst.)
Chrysomelidae:	*Crioceris asparagi* (Linn.)
	Crioceris duodecimpunctata (Linn.)
	Lema trilineata Oliv.
	Lema palustris Blatch.
	Cryptocephalus quadruplex quadriguttulus Suffr.
	Cryptocephalus mutabilis Melsh.
	Nodonota tristis (Oliv.)
	Colaspis favosa Say
	Tymnes metasternalis (Cr.)
	Chrysochus auratus (Fab.)
	Labioderma clivicollis (Kby.)
	Zygogramma suturalis (Fab.)
	Calligrapha elegans (Oliv.)
	Calligrapha philadelphica (Linn.)
	Plagiodera versicolor (Laich.)
	Galerucella americana (Fab.)
	Galerucella notulata (Fab.)
	Galerucella luteola (Mull.)
	Diabrotica undecimpunctata howardi Barber.
	Acalymma vittata (Fab.)
	Blepharida rhois (Forst.)
	Disonycha triangularis (Say)
	Disonycha xanthomelas (Dalm.)
	Chalcoides nana (Say)
	Chalepus bicolor (Oliv.)
	Chalepus scapularis (Oliv.)
	Chalepus dorsalis Thunb.
	Baliosus ruber (Web.)
	Chelymorpha cassidea (Fab.)
	Deloyala guttata (Oliv.)
	Plagiometriona clavata (Fab.)
	Metriona bicolor (Fab.)
Brentidae:	*Arrhenodes minutus* (Drury)
Anthribidae:	*Euparius marmoreus* (Oliv.)

Curculionidae:	*Rhynchites bicolor* Fab.
	Attelabus analis Ill.
	Attelabus nigripes Lec.
	Pterocolus ovatus (Fab.)
	Brachyrhinus sulcatus Fab.
	Aphrastus taeniatus Gyll.
	Phytonomus comptus Say
	Gymnetron tetrum (Fab.)
	Lixus musculus Say
	Lixus concavus Say
	Cylindrocopturus quercus (Say)
	Rhyssematus lineaticollis Say
	Cryptorhynchus lapathi (Linn.)
	Rhodobaenus tredecimpunctatus (Ill.)
Scolytidae:	Unidentified species.

Mollusks

By

MATHILDE E. WEINGARTNER

THE VARYING TERRAIN and the presence of fresh and brackish water at the William T. Davis Wildlife Refuge provide suitable habitats for the members of the Phylum Mollusca, which are well represented there. Commercially, however, they are unimportant since they furnish neither human food, fertilizer, nor any other marketable product.

In the balance of nature, though, these mollusks play an important part. The aquatic species help to purify the water in which they live, consuming quantities of plankton, fresh water algae, decaying vegetable and animal matter. Hence, in this manner, the

water is kept from becoming foul or choked with vegetation. The land snails eat living and dead vegetation, fruit, and fungi.

Even though a snail's shell may seem to afford excellent protection, it must nevertheless extend its "foot" out of the shell in order to move about. This "stomach foot" is a wide, flat muscle on the underside of the body, giving rise to the name "gastropod," by which all slugs and snails are known. Gastropods have tentacles and paired eyes. Land snails have their eyes on the ends of retractile stalks. Being detrimentally affected by a lack of moisture, these animals like to forage at night, when the humidity of the air is high and the hot rays of the sun cannot dehydrate their soft bodies. In traveling from place to place, snails lay down a trail of mucous which can be seen several hours later; hence they can be tracked easily for observation.

Both land and fresh water snails at the Wildlife Refuge are pulmonates; that is, they breathe by means of a respiratory sac which opens to the outside of the body through a respiratory pore in the edge of the mantle. (The mantle is the fleshy web that covers the body and lines the shell.) Pond snails, therefore, must come periodically to the surface of the water to breathe.

On the edge of the salt water creeks we find, half buried in the mud, many *Volsella demissa* (ribbed mussels). These bivalves open up at high tide and sift water through their syphons and bodies, extracting micro-organisms for food and oxygen. At low tide these animals close their valves, thereby protecting themselves from both dehydration and enemies while they await the water's return.

An unusual and interesting snail called "Coffee Shell" (*Melampus bidentatus*) may be found in the grasses along these brackish water creeks and ditches. It was here (Z3-B4) that Dr. Joseph Morrison of the National Museum in Washington located the egg masses of these mollusks, much to his delight, after having searched for them in many places in the United States. These animals live mostly out of water. They are suspected of being a transitional form between marine creatures and land snails. They have a useful lung for breathing air; however, they cannot stand drying out for long periods of time. They follow the tide level very closely, crawling up and down the stems of vegetation as the tide advances and recedes. At times they may be found crawling around in wet places.

The Left-handed Pond Snail (*Physa heterostropa*) is probably our only representative of fresh water gastropods in the area.

These snails are able to cover their entire shells with the mantle so that they look more or less like small globs of mucous, and easily escape observation.

The land snails comprise the largest group of mollusks in the Refuge area. The most common of these probably is the Umbilicated Forest Snail (*Mesodon thyroidus*), which can be found under decaying leaves in most of the wooded areas. If the empty shell still has the periostracum (epidermal tissue surrounding the shell), it is uniformly amber-colored; but, if the animal inhabits the shell, the dark markings on the mantle show through.

Zonitoides arboreus (no common name available) lives under stumps and in damp places, close to the ground. These small animals, very common in the Refuge, have shells less than one quarter of an inch in diameter, light glossy brown in color.

Ventridens ligera, form *stonei,* was discovered by members of the New York Shell Club in the open fields between the two strips of woodland at the Refuge. Here (B9-Z1) it lives among the grasses close to the ground, sometimes under logs. This particular form differs from the regular species by having a yellow rather than a white deposit at the bottom of the shell.

Discus cronkhitei catskillensis inhabits a small shell, about a quarter of an inch in diameter, which possesses many whorls and is characteristically ribbed, as may be easily seen under a lens. Its typical habitat is under logs in the woodlands.

A mollusk, *Gastrocopta tappaniana,* new to the New York area, was found at the Wildlife Refuge by Miss Margaret Tesky of Buffalo, New York, in July, 1955. This is a small snail, with its whorls wound up one on top of the other, turban fashion, and the lip of its aperture possesses many teeth. Miss Tesky's specimen was found near a boulder bordering the brook. The writer has been unable to uncover any more specimens—a failure that may be due to incomplete data on locality or to the secretive nature and protective coloring of these mollusks.

Succinea ovalis, the oval amber snail, on the other hand, is fairly large and more easily seen. It always lives close to the water and has been known to swim from place to place. It will crawl up the blades and leaves of vegetation. The author has found one about three feet from the ground on a cat-tail blade.

Deroceras reticulatum, a slug, is a newcomer to this country, probably having been introduced from Europe on plants. A large number were found on the Japanese honeysuckle after a rain in September, 1956. The breathing pore of this slug is easily seen on the left side of the body. Like many other slugs, *Deroceras reticulatum* has a rudimentary shell under the mantle.

The macro niche presented by the William T. Davis Wildlife Refuge to this group of animals is favorable for several reasons. Among them the infrequency of brush fires has permitted the increase of land farms. Flower growing and vegetable farming in and near the area have resulted in the importation of exotic species. The presence of both fresh and salt water provides a suitable habitat for various aquatic species.

Diligent search, possibly at night, might reveal species other than those listed here, many forms being nocturnal. Although ample moisture is necessary to the well-being of the mollusks, flooding the area would doubtless destroy many of them.

The eventual change from brackish to fresh water, which may naturally be anticipated, will be responsible for great changes in the molluscan fauna.

The enemies of the mollusks are many. Aquatic species are consumed by birds such as ducks, snipes, gulls, crows, and rails. Turtles like to eat slugs and snails. Mice, chipmunks, and squirrels easily bite through the snail's shell. Muskrats have been seen to wait for the snails to expose the soft parts of their bodies, and then quickly snatch them up. Ground beetles of the family *Carabidae,* genus *Scaphinotus,* have also been known to attack and relish land snails.

LIST OF MOLLUSKS

Volsella demissa Dillwyn — Ribbed Mussel
Melampus bidentatus Say — Coffee Shell
Physa heterostropa Say — Left-handed Pond Snail
Mesodon thyroidus (Say) — Umbilicated Forest Snail
Ventridens ligera Form *stonei* Pilsbry
Zonitoides arboreus (Say)
Discus cronkhitei catskillensis Pilsbry
Gastrocopta tappaniana (C. B. Adams)
Deroceras reticulatum (Muller)
Succinea ovalis Say
Carychium exiguum (Say)

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Birds

By

CASIMIR F. REDJIVES

THE BLACKBIRD, robin, towhee, and brown thrasher are the first birds to appear in the Refuge. However, the big spring movement there takes place during the first three weeks in May; then the migrations of warblers are a sight to behold. The observer finds the time all too short to study the beautiful, butterfly-like coloration of these small birds as they travel on their northward course.

Early in the season, the chickadees greet the naturalist as he follows the paths in the Refuge. The careful listener can hear fox sparrows scratching among the dry leaves on the ground, looking for seeds and insects that may so far have escaped their notice. The chatter of the downy woodpecker may be heard as he probes for food among the trees.

The clearing at the feeding station is a good place for the naturalist, armed with binoculars, to take his stand to study the spring migrations. If the day is clear, as many as a hundred species may be seen, but space here does not permit the discussion of more than a selected number.

The red-winged blackbird is one of the earliest bird visitors to the Refuge and may be seen and heard in the swampy areas. This blackbird cannot be mistaken for any other because of his bright red epaulettes. The males are the first to arrive, about the middle of February. Shortly afterwards the females arrive and the selection of nesting sites is made. The nests may be found anywhere from a few inches to ten feet above the ground. Eggs are from four to six in number, but mostly four. They are pale bluish or greenish in color, with black and dark brown markings. This bird feeds on seeds, cutworms, grasshoppers, and other insects.

The downy woodpecker also nests early in the season, choosing holes in dead trees, anywhere from eight to eighty feet above the ground. Four to six shiny white, pinkish tinged eggs are laid. These woodpeckers may be observed during the winter months also, particularly near the feeding stations, since they substitute suet for their summer diet of grubs. The male has a short bill, a white rump, and a small red patch on his head. Being fairly tame, these, our smallest woodpeckers, will often come within reach, but the least disturbance makes them fly away. These birds are plentiful and may be seen almost anywhere along the roads and in the woodlands.

A year-round resident is the song sparrow. Its heavily streaked breast, with brown stripes merging into a central spot, can easily be recognized. An outstanding characteristic of this bird is the pumping of its tail when in flight. Song sparrows are common in the Refuge, often seen particularly along the roadside near the buildings not far from the main entrance. The nest is made on the ground under tussocks of grass. The eggs number four to five and are bluish white. During the summer months these birds will come to the feeding station, but they prefer wild seeds.

Along the outskirts of the Refuge the observer will often find one of our loveliest singers, the robin. Its clear, whistled, caroling song is made up of short phrases of two or three notes and is often long and continuous. Young robins have speckled breasts, gray backs, and rusty underparts. Four eggs—rarely five—are laid,

bluish-green (robin's-egg blue) in color. The robins' food consists of earthworms, ripe cherries, grubs, and caterpillars. In the fall they eat chokeberries and many other kinds of wild fruits found in the Refuge.

The brown thrasher may be encountered along the edge of the woods in the Refuge. Slightly larger than a robin, this slim bird has a bright rufus-red back and heavily striped breast, white wing bars, a curved bill, and a long tail. The eye is yellow. The Refuge's hedgerows, thickets, and dry fields overgrown with shrubbery and vines are to its liking. The nest is made close to the ground and sometimes right on the ground in a dense thicket. Usually four eggs are laid, grayish white in color, speckled with minute spots of cinnamon or rufus brown. The food of the thrasher consists of insects and worms, but when it has young waiting to be fed it may be found at the feeding station in the Refuge.

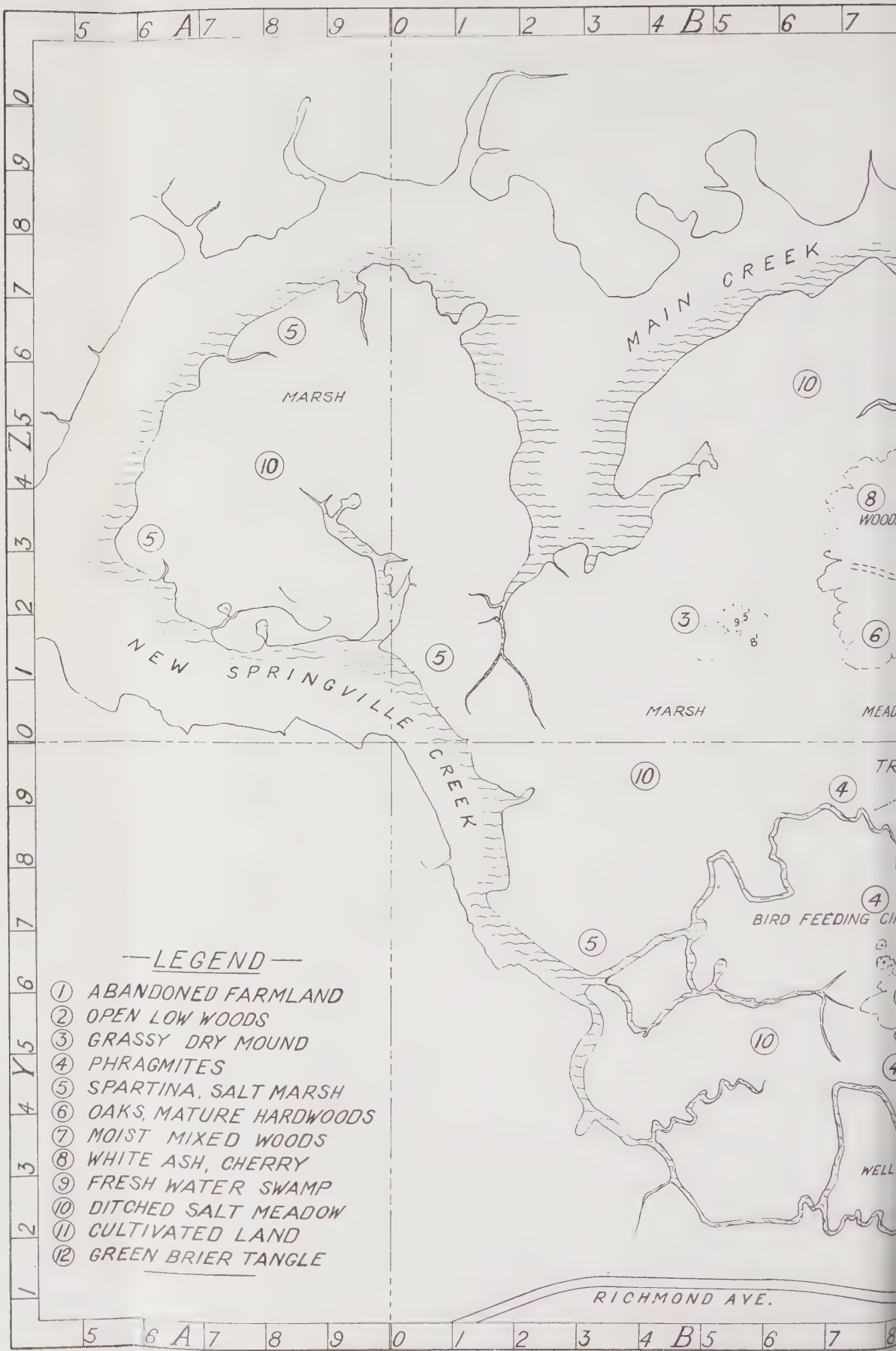
Coming to the dry area of the Refuge, one more than likely will spot the chewink, a bird which likes the hedgerows, thickets, and hillside slashings. Its sides are robin-red; its belly, white. The male's entire head and upper parts are black, and in flight it looks black with white spots showing toward the outer tips of its ample tail. The female is similar in coloration except that she shows dusky brown where the male is black. The chewink makes its nest on or near the ground. The eggs are usually four in number and are white or grayish white, with fine, even speckles of reddish brown. In spring this bird feeds on insects and other animal food found in the Refuge. Later, in summer, it rounds out its diet with seeds and wild fruit, and will often visit the feeding stations.

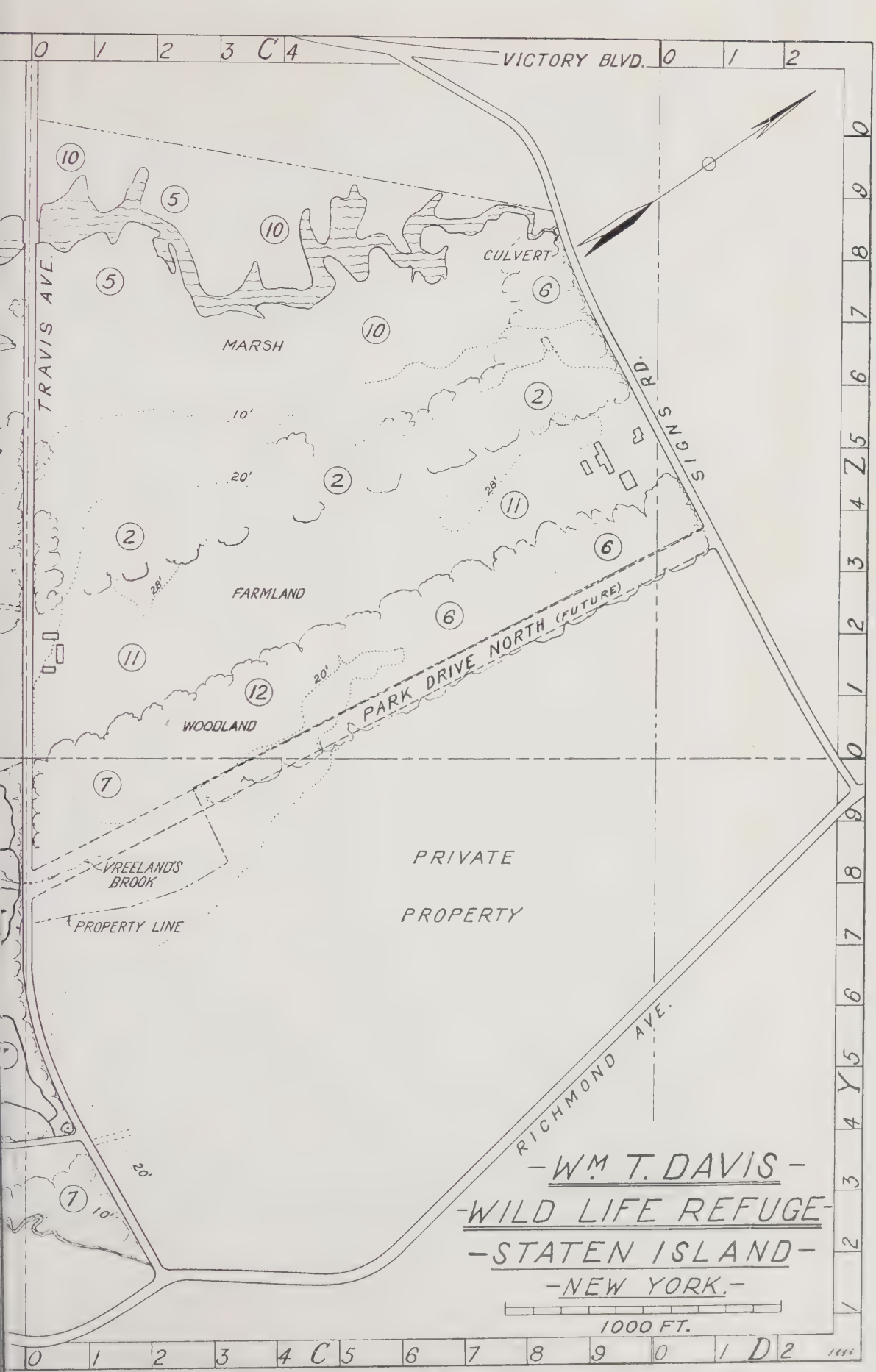
A path in the Refuge leads to an open field which at one time was farmed. Here the high grass and the tall weeds make an ideal spot from which to flush the ring-necked pheasant. When this bird rises from almost beneath one's feet, as often happens, its sudden flight and raucous call can give the unprepared "birder" quite a scare. About the size of a leghorn chicken, but considerably more brilliant in plumage, the highly-colored male has a white ring around his neck, and a long, sweeping tail. The female is mottled brown with a shorter, pointed tail. Pheasants in the Refuge build their nests on the ground in small depressions. The clutch contains from eight to fourteen eggs. Their young are able to run about as soon as hatched. Grasshoppers and other insects form the pheasants' diet. During the winter they become quite tame and will use the feeding station to round out their food supply.

A bird often seen near the Refuge entrance is one introduced from Europe—the starling. It is a short-tailed bird, with glossy purple and green feathers and a yellow bill which easily identify it in the spring; in winter, however, the bird is speckled. Starlings are gregarious and flocks of them may be seen walking across a field, like a well deployed army, seeking food. In the evening they gather in still larger flocks, to find a roosting place. The nests are made in holes of trees, boxes, or almost any place that the birds can get into. Four to seven eggs are laid, pale greenish in color. The starlings' food includes worms, grasshoppers, and berries.

Anyone walking through the Refuge will often hear the harsh slurring "jeeah" of the blue jay, which is an effective warning to other creatures in the woods that a stranger is about. Easily recognized by its bright blue color, this bird is larger than a robin, whitish below, and crested. It has a range of musical notes in addition to the rusty hinge call that is generally heard. Blue jays may be found almost anywhere in the Refuge. Sometimes several will gather when an intruder has been spotted, and then they really give vent to their feelings! These birds make their nests in evergreens, in shrubbery, and in trees with rather heavy foliage. Three to six eggs are laid, their color a pale olive green on a buff ground. Like a number of other birds, the blue jays may destroy the eggs of other birds nesting in the area, but most of their food consists of injurious insects, fruit, nuts, and other foods that come their way. Their habit of carrying nuts has served as seed dispersal, starting many forests.

The cardinal is easily identified—it is the only bird in the East that is entirely cardinal red and has a crest. The female is yellowish brown and has a crest and heavy bill. The cardinal likes heavy shrubbery and nests in such places as catbriar and wisteria vines, where the approach is difficult. The nest may be from three to eight feet above the ground, depending upon the type of vegetation in which it is built. It is composed of twigs, rootlets, and bark. Three to four eggs are laid, a pale bluish white in color, speckled with brown. The cardinal usually stays all winter in the neighborhood where it has nested. During the summer its diet consists of fruit and seeds, but during the winter it is seen at the Refuge feeding station, where it looks for the sunflower seeds that are mixed with the other food.


MAIN CREEK
MARSH
NEW SPRINGVILLE CREEK
MARSH
BIRD FEEDING CI
RICHMOND AVE.
—LEGEND—
(1) ABANDONED FARMLAND
(2) OPEN LOW WOODS
(3) GRASSY DRY MOUND
(4) PHRAGMITES
(5) SPARTINA, SALT MARSH
(6) OAKS, MATURE HARDWOODS
(7) MOIST MIXED WOODS
(8) WHITE ASH, CHERRY
(9) FRESH WATER SWAMP
(10) DITCHED SALT MEADOW
(11) CULTIVATED LAND
(12) GREEN BRIER TANGLE


VICTORY BLVD.
TRAVIS AVE.
SIGNS RD.
CULVERT
MARSH
FARMLAND
WOODLAND
PARK DRIVE NORTH (FUTURE)
VREELAND'S BROOK
PROPERTY LINE
PRIVATE
PROPERTY
RICHMOND AVE.
10'
20'
28'
-WM. T. DAVIS-
-WILD LIFE REFUGE-
-STATEN ISLAND-
-NEW YORK.-
1000 FT.

Almost every place in the temperate zone has a crow of one sort or another, and the Refuge is no exception. Anyone entering there soon becomes aware of its raucous call, warning of the presence of a stranger. Crows can be seen anywhere on Staten Island, in the woods, the open country, or at the sea shore. In early June the nest of the crow may be found in the fork of a tree many feet above ground. The bird lays three to five eggs (generally four), pale blue to olive green in color. The food of the crow varies with the season, and it eats insects, cutworms, larvae, and other injurious forms of animal life. Grain, dead cattle and dead fish are also included in its diet.

In the open fields around the Refuge a flash of yellow and black may be seen as the goldfinch undulates in its flights overhead. These birds can be seen often in the once-worked field previously mentioned. The male is bright yellow with black wings and black cap; the female, a dull olive-yellow with blackish wings. They do not like the closed wood, but prefer the dry open fields overrun with thistles. Goldfinches are seed eaters. They build their nests much later than our other birds—usually in late July or early August—and choose bushes or low trees. They usually lay three to six white eggs.

One of the greater finds in birding is the nest of the alder flycatcher. This bird builds its nest in alders, spirea, or willows, at from one and a half to four feet above the ground. Three to four eggs—creamy white, sprinkled with brown—are laid. Miss Mathilde Weingartner discovered one of these nests in an oak tree at the edge of a swampy area in the Refuge.[B9-Z9] The alder flycatcher may be identified by its dark back, white eye ring, and two wing bars, in addition to its characteristic song. Its food consists mainly of flying insects.

Occasionally, in the high trees along the section of Travis Avenue which runs through the Refuge, the wood peewee may be heard and sometimes seen. This sparrow-sized flycatcher, dusky olive-brown above and whitish below, has two conspicuous wing bars, and its lower mandible is yellow. Flying insects make up the greater part of its diet. Wood peewees build their nests on horizontal limbs of trees anywhere from six to thirty feet above the ground. The creamy white eggs are from two to four in number, more or less heavily spotted.

The crested flycatcher may sometimes be sighted sitting on a dead branch in the top of a tree bordering the clearing at the feeding station in the Refuge. About the size of a robin, it has a grayish

back, rufus tail, gray throat and breast, and yellow belly. Its food consists of flying insects. For a nesting site, ten to fifteen feet from the ground, it may choose an old woodpecker hole or a hollow tree. The eggs are ground-colored, or rich cream, five to six in number.

In the open areas of the Refuge, especially around the cattail marsh, a few dead trees provide vantage points for the kingbird, who may be seen sitting there and surveying the world around him. This large flycatcher can be recognized in flight by its black back and the white band at the tip of its tail. Its red crown mark is rarely noticed. It seems to fly on the tips of its wings. This bird prefers open fields and roadsides. It often sits on telephone wires or fence posts to watch for the flying insects, such as bees, flies, and grasshoppers that comprise its food. Kingbirds nest from six to twenty feet from the ground, in thorn bushes or shady trees. The four to five eggs are creamy white, rather coarsely spotted with reddish brown. The kingbird really lives up to its name, "tyrannus." It fears no bird large or small, and if a hawk or crow comes anywhere near its nest it will attack and chase away the intruder.

Often a "flicker" that has been feeding on ants may be flushed along the borders of the Refuge or in the clearing about the feeding station. It is larger than a robin and is the only brown-backed woodpecker that we have in the East. Noticeable flashes of yellow under wings and tail can be seen when it is in its dash-like flight, but its conspicuous white rump is the best field mark. At close range, a wide black crescent shows across the breast, a red patch at the nape of the neck, and, in the male, black face whiskers. Flickers hunt on the ground for the ants and grubs that are their chief food, and may be found in the open fields, hedgerows, or the borders of dry woodlands in the Refuge. Their nests are made in holes which they have laboriously pecked out of trees, although sometimes they will use a readymade cavity in a hollow tree. These holes may be from fifteen to thirty feet above the ground, and range in depth from ten to twenty-four inches. The eggs are pure white.

At the outer edges of the Refuge mourning doves find a suitable habitat. Smaller than domestic doves, these birds have a pointed tail and show large white spots as they fly. These are the only wild doves that live in the East, hence there are no problems in identification. Their mournful call often betrays their whereabouts. Two pure white eggs are laid in a poorly built nest, found usually in the thick branches of a tree. These birds feed chiefly on grain, weed seeds, and insects.

During the hottest hours of a quiet summer day, the song of the red-eyed vireo may be heard in the Refuge. The hot humid weather is no deterrent to this cheerful songster, who may remain invisible in the tall deciduous trees along Travis Avenue. The size of a sparrow, it is olive green above, white below, with a gray cap, and black-bordered white stripes over the eye. The nest, woven and basket-shaped, is made of grasses and bark. During the breeding season it contains three or four eggs, white in ground color and spotted with black, umber, and reddish brown. This vireo's food consists of caterpillars, beetles, and other insects.

The willow swamp (Y8-B9) in the Refuge clearing affords another view of bird life that is highly interesting. Here a house wren has chosen old dead trees for its nests. These birds are apt to return to the same spot year after year and may be found almost anywhere in the Refuge. The house wren may be recognized by its brown color, its habit of cocking its tail over its back, and its small size (approximately two inches in body length). Its food consists mainly of soft-bodied insects and spiders. It lays six to eight eggs, which are pinkish brown with minute speckles.

Sooner or later, the catbird will quietly come to inspect the visitor to the Refuge. This bird is smaller than a robin and has a black cap, a slate-colored back, and chestnut red under-tail coverets. Catbirds are rarely found in dense woods; they prefer clearings and human habitations. They like to build their nests a few feet from the ground in barberry bushes and other dense shrubbery. The eggs, three to five (usually four) in number, are deep bluish-green in color. Although the catbird feeds on destructive insects, it makes use of the feeding station during the summer to supplement its diet.

Another interesting bird to be found along the edge of the Refuge is the northern yellow throat. This small warbler can easily be recognized by the black mask over its face. Sometimes it is called the black masked bandit. The female, although it lacks the mask, has the same coloration as the male—olive brown with a rich yellow throat, buff yellow breast, and white belly. The coloration of this bird makes it difficult to see, blending as it does with the general background. This tiny warbler dwells in low bushes and on the ground. For nesting areas it favors low vegetation in swamps, such as tussocks of marsh grass. The eggs average four in number, and are shiny white in ground color, speckled with reddish brown. The northern yellow throat feeds on caterpillars or other insects.

The black-billed cuckoo is sometimes sighted in the Refuge, but it, too, is hard to locate because its color blends with the surrounding foliage. It is about the size of a robin, but slimmer, with a longer tail that is marked with "thumbprints." It is brown above and white below, has a black bill, and a narrow red ring around the eye. The dense foliage of shrubs, tangled vines, or trees two to ten feet high provide the nesting area for this bird. The nest is lined with moss and pieces of bark. The eggs, three to seven in number, are greenish blue. This cuckoo lives chiefly on caterpillars, and it does its share in helping to eradicate the tent caterpillar.

The wood thrush is frequently seen feeding among the leaves on the ground in the dry wooded area of the Refuge. Slightly smaller than the robin, with breast and sides heavily spotted, it is plumper than the other thrushes and can be distinguished from them by a deepening redness about the head. The wood thrush builds its nest on limbs of trees or saplings, or in the forks of trees, from eight to thirty feet above the ground. The eggs are three to five (generally four) in number and greenish blue in color, almost like those of the robin. Its chief food is wild fruit—dogwood berries, June berries, viburnum berries, and wild cherries.

More often heard than seen, the long-billed marsh wren makes its home in the cattail marshes of the Refuge. Brown with a conspicuous white line over the eye, this interesting small songster is easily distinguished from other wrens by the white stripes on its back. The flooded marshes, sedges, and cattails are its nesting grounds. An interesting characteristic of this bird is its habit of building a number of nests before deciding to settle down. Usually six to eight nests are built, composed of dead leaves woven with stems of flags and grass, before the eggs are finally laid. They number from five to nine, and are thickly mottled with chocolate-colored spots. Marsh insects and spiders constitute this bird's food.

When the nesting cycle has been completed and the young are able to fend for themselves, a new phase of bird life takes place at the Refuge. When the berries and fruits are ripened and the seeds are hardening, most of the "summer" birds prepare to leave the Refuge, but their departure does not leave it barren or still. The cardinals remain along the outer rim where the shrubs are thickest. Pheasants are to be found in the meadows. The ever-present noisy starling continues to live around the buildings at the entrance. Along the paths and at the edges of the woodland the song sparrow can be found all through the winter.

An interesting change takes place when birds that have left for the south are replaced by northern visitors. It is not unusual at this time to find a flock of purple finches in the tree tops or among the shrubs, feasting on buds and seeds. Sometimes these birds will stay all winter. At this season the purple finch loses its purplish-wine color and more nearly resembles the English sparrow except for the heavy bill and streakings which distinguish it.

Another visitor, the white-breasted nuthatch, may be seen creeping down the trunks of trees, and his cousin, the red-breasted nuthatch, may also be observed.

The black-capped chickadee, the acrobat of the woods, comes down from the north and stays for the winter. He gives an impression of great activity, and often is seen swinging head downward from a branch, singing his characteristic song.

Fox sparrows are seen in early and late fall, but the white-throated sparrow stays throughout the winter. The tree sparrow may be found along the outer edges of the phragmites area—easily identified by the blackish spot on the center of the breast, two wing bars, and chestnut-rufus crown.

At no season is the Refuge bereft of birds, and many species may be spotted by the alert year-round ornithologist. During times of extreme cold and heavy snow, most of the wintering bird population may be found in the area of the feeding station, taking advantage of the food left there for them by the members of the Section of Natural History.

LIST OF BIRDS

Ring-necked Pheasant
Mourning Dove
Black-billed Cuckoo
Flicker
Downy Woodpecker
Kingbird
Crested Flycatcher
Alder Flycatcher
Wood Pewee
Crow
Blue Jay
Chickadee
White-breasted Nuthatch
Red-breasted Nuthatch
House Wren
Long-billed Marsh Wren
Brown Thrasher
Catbird
Woodthrush
Robin
Red-eyed Vireo
Northern Yellowthroat
English Sparrow
Starling
Red-winged Blackbird
Cardinal
Purple Finch
Goldfinch
Towhee
Tree Sparrow
White-throated Sparrow
Fox Sparrow
Song Sparrow

The following birds seen at the Refuge have been reported to the author by other birdwatchers:

Green Heron
Mallard Duck
Black Duck
Wood Duck
Red-tailed Hawk
Red-shouldered Hawk
Marsh Hawk
Sparrow Hawk
Clapper Rail
Killdeer
Woodcock
Greater Yellowlegs
Lesser Yellowlegs
Barn Owl
Screech Owl
Chimney Swift
Ruby-throated Hummingbird
Hairy Woodpecker
Phoebe
Barn Swallow
Tufted Titmouse
Brown Creeper
Carolina Wren
Hermit Thrush
Veery
Bluebird
Cedar Waxwing
White-eyed Vireo
Meadow Lark
Rusty Blackbird
Purple Grackle
Scarlet Tanager
Indigo Bunting
Pine Siskin
Sharp-tailed Sparrow
Junco
Swamp Sparrow

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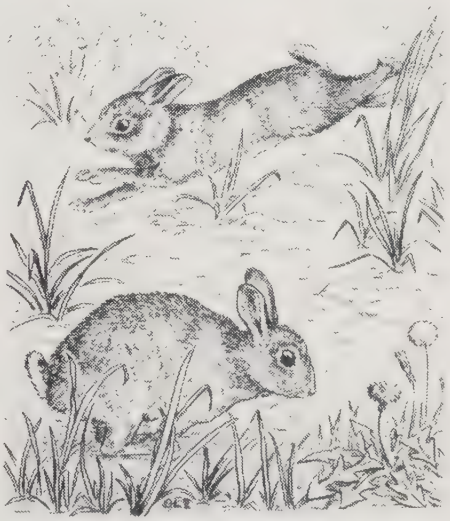
Mammals

By

ROBERT F. MATHEWSON



The study of mammals, although of some interest, has never been as popular as the study of birds—probably due to the more secretive nature of mammals. Various species of mammals occur in the William T. Davis Wildlife Refuge, and this brief article is

designed to serve as an introduction to them and an invitation to share in the rewarding study of these animals.

More and more, the ecological relationships of one animal to another are taking the interest of the student. Such a study calls for greater knowledge of the life histories and habits of all wildlife. Articles in this and the preceding issue of the *Proceedings* provide good introductory information about many of the plant and animal populations of this region. The Refuge offers a unique opportunity to the serious student of ecology. The gradual environmental changes which take place here as a result of man's influence will be easy to record. A continuous check on both the macroscopic and the microscopic niches can be accomplished with comparatively little effort. The Refuge provides an ideal situation--a field study under laboratory conditions.

Already, pressures created by man in the adjacent areas are evident in the abnormally large number of species of mammals which inhabit the 160 acres comprising the Refuge. In the few years that the writer has collected* and recorded mammal populations there, twenty species have been observed (this includes man). The total number of recorded species throughout the Borough of Richmond is thirty-one. (This does not include the marine forms that occasionally visit our shores.)

Probably the occurrence of this unusually high number of mammals can be accounted for by (1) the isolated character of the Refuge with the consequent protection it affords from the presence of man, and (2) the varied terrain and vegetation found within the boundaries of this sanctuary. The map on pages 24 and 25 shows the topographical and botanical characteristics of the Refuge, and articles on these features in the preceding issue of the *Proceedings* provide even greater detail.

Forms such as bats, opossums, and rabbits are not confined to any one segment of the Refuge and have been recorded from every biotic zone.† During the winter, after heavy frost and snow, even the salt marsh is visited by these forms, excepting bats.

Preferences of habitat shown by the remaining species are somewhat consistent and are noted in the discussion of each species.

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* Released after live trapping. Conservation permit No. 1320.

† Large topographical zones as indicated on the map on pages 24 and 25.

OPOSSUMS

Virginia opossum, common opossum, and eastern opossum are the common names applied to our local species *Didelphis virginiana.*

The opossum, a marsupial (possessing a "marsupium" or pouch containing mammary glands, serving as a receptacle for the young), is fairly common at the Refuge. It is about the size of a small dog or house cat and has a long, naked tail and large, smooth, naked, pink-colored ears. Its fur is interspersed with long guard hairs, usually gray, and the under fur is soft and grayish. Young opossums are usually a lighter, almost white color. The forefeet, which are five-toed, leave tracks that resemble imprints made by small human hands. Both sexes are similar in color and size. These animals are both terrestrial and arboreal. When in the trees they use their prehensile tails as an extra "hand." The opossum is omnivorous, eating small birds and mammals, frogs, fish, insects, fruits, etc. This trait probably contributes largely to their persistence at the Refuge. Man, disease, and an occasional great horned owl are their outstanding enemies.

The more heavily wooded and isolated parts of the Refuge are the opossum's typical habitats; however, an individual has been observed along the wooded border of Travis Avenue. This animal was probably interested in garbage spilt from a can at the farmhouse there. The many birds that build their nests in the Refuge, the abundance of insects, the killie fish and the hard shell shrimp that occur in the tidewater creeks, all are attractions that lure the opossum to this area.* One dead (D.O.R.) and four live specimens have been observed at the following sites: C7-Z5, C3-Z6, C0-Z3, and B5-Z6 (on map pages 24-25).

SHREWS

The least shrew, smoky shrew, short-tailed shrew, masked shrew, and probably the long-tailed shrew occur on Staten Island. At the Refuge, however, only two of the species have been recorded. The least shrew, *Cryptotis parva,* and the short-tailed shrew, *Blarina brevicauda,* have been trapped and observed.

* All plants and animals are protected in the Wildlife Refuge. Those who are predators tend to keep a natural balance, and when the food supply runs low they are prone to move out.

These animals, with their pugnacious attitude and ready display of courage (they have no hesitancy about attacking an adult human), command admiration. Neither of the species trapped ever weighs much more than an ounce. Their favorite habitats are in the wetter areas of the Refuge, along the edges of fresh water streams and swamps. However, specimens have been collected from many sites through the wooded sections.(B8-Z3, B9-X8, C9-Z6, C2-Y8) Their nests are constructed under stones and fallen logs, with some preference shown for elm; but that may be due to the greater availability of that material. Their food consists almost entirely of insects, but they do not hesitate to attack and kill small rodents and birds.

The least shrew is some two and a half inches long, brownish or cinnamon colored, and weighs about seven grams. The larger, four-inch, gray colored, short-tailed shrew weighs about eighteen grams. Both animals look like small rodents, but a close examination reveals dentition and osteological features that distinctly separate them from the rodents. The shrews' extremely high metabolic rate necessitates their feeding almost continuously; hence the careful observer may sometimes see them during the day, particularly in warm weather. It has been estimated that they eat more than their own weight every twenty-four hours.

MOLES

No difficulty is encountered in identifying the two species of moles found in the Refuge. The distinct fleshy finger-like projections found on the nose of the starnose mole, *Condylura cristata*, readily separate this form. My trapping records indicate that these two animals have different habitat preferences. The starnose mole was invariably found in the wetter portions of the Refuge.(B9-Y7, B9-Y6) Two years ago, many mounds created by this animal's movements beneath the surface of the ground could be found crossing and recrossing the paths in the "open" part of the Refuge. However, the moles were probably disturbed constantly by visitors walking through this area, and this has caused them to migrate to the more secluded segments of the sanctuary. The eastern mole, *Scalopus aquaticus*, which populates lawns, meadows, golf courses and similar areas of drier soil, is found in the higher and drier places, such as the edges of the open farmland and the wooded tracts near Signs Road.(D0-Z5) Even though but a few of these small

soft-furred animals are ever seen, they are perhaps among the more common mammals of the Refuge. Secretive by nature, they spend most of their time in subterranean passages in quest of food—earthworms and insects, and their immediate retreat at the first sign of danger makes them seldom seen.

BATS

Although many observations have been made by the author and by his colleagues and the Park Department workers, not a single bat roost has been recorded at the Refuge. What would appear to be ideal roosting habitats are available, such as open rafters in the barns at the Park Department supply depot and at the farmhouses. These places were carefully watched on numerous occasions, at early dusk, to determine their possible bat populations—but to no avail.

Many flying specimens have been seen along Travis Avenue and over the open fields.(B7-Z1, C0-Z1, 4, 5, 6) Positive identifications are lacking; however, we are confident that the little brown bat, *Myotis lucifugus;* the big brown bat, *Eptesicus fuscus;* red bat, *Lasiurus borealis;* and the hoary bat, *Lasiurus cinereus,* have been seen in this area. The evening bat, *Nycticeius humeralis;* the keen bat, *Myotis keeni;* the eastern bat, *Pipistrellus subflavus;* and the silver haired bat, *Lasionycteris noctivagaus,* are the other species that occur on Staten Island and probably also at the Refuge. Contrary to the popular belief that all bats hibernate during the winter months, some species migrate to the warmer climates during the cold weather. Hoary bats and some individuals of the big brown bat species migrate to the southern border of the United States.

Owls are perhaps the most important natural predators of these small mammals. The bats' excellent flying ability, and a unique "radar" system (actually sonar) provide them with an effective protection against most predators. Like sonar, this equipment consists of (1) the emitting of a high frequency note by the bat which (2) "bounces off" any object in the vicinity, thereby alerting the bat not only to its presence but to its exact location. These small flying mammals are economically important due to their insect eating propensities. An adult bat can devour its own weight in insects, while on the wing, each night.

MICE

Mice are the smallest members of the large group known as rodents. Squirrels, chipmunks, rats, and mice comprise the Staten Island membership of this group.

Like all the rest of this "family," mice are "gnawers" and are equipped with an upper and lower set of incisor teeth. The chisel-like edges of these teeth meet at the front of the mouth. This type of dentition enables these animals to cut through the hard surfaces of seeds and nuts, which comprise the greater part of their diet. The whitefooted mouse, *Peromyscus leucopus,* a small four-inch, reddish brown to grayish brown animal with white stockings and underparts, and the field mouse, *Microtus pennsylvanicus,* a larger five-and-one-half-inch animal with a silvery belly and long dark brownish or reddish fur above, are quite unlike their "city cousin," the house mouse, *Mus musculus,* which attains the size of three and one half inches and is uniform gray in color. As the name implies, the house mouse is invariably a house dweller, seldom leaving human habitation except to migrate to another home. Both the whitefooted and the field mouse prefer to build their homes in the woodlands, and are not considered to be the economic and annoying pest that the house mouse is.

Although specimens were collected in but few sites at the Refuge (B8-Y5, C3-Z2, C1-Z4) it is highly probable that no places, except the inundated areas, are completely free of these rodents.

RATS

The Norway rat, *Rattus norvegicus,* like the house mouse prefers to live in or near human habitation. An exception to these preferences is provided by the garbage dump land-fill project that adjoins the Refuge—which is undoubtedly a strong attraction. Specimens were both observed and collected around the Park Department storage buildings and near the barn along Travis Avenue.(B9-Y4, C0-Z2) The dirty gray-brown color of their usually sparse pellage, and their naked tails and ears readily identify these seven to ten-inch-long animals. It is not unusual for these animals to be infected with some sort of skin disease. Perhaps pathogenic infections are their most important control. These animals have a serious effect upon the balance of the wildlife populations in the area. Their cunning, ravenous appetites, and fearlessness enable

them to destroy birds, small rodents, eggs, rabbits, and other small animals. Unlike these forms, they can migrate out of this area and readily adapt to a radically different type of habitat.

The clean sleek appearance of the muskrat, *Ondatra zibethica,* with its deep dark reddish brown pelt and laterally flattened tail, makes it quite distinct from the Norway rat. The habitat preference of this animal is in the marshland; however, two specimens were seen migrating through an open field toward Travis Avenue.(B9-Z2) These animals are still trapped on Staten Island (not at the Refuge) for their pelts. They attain a body size of from ten to fourteen inches with a tail length of eight to eleven inches. An adult specimen may weigh as much as five pounds. Their homes are built in the banks of the brackish water streams and fresh water marshes. The typical conical houses, which are built of twigs, grasses and mud in the middle of swampy areas, have never been observed in the Refuge.

SQUIRRELS

Both the gray squirrel, *Sciurus carolinensis,* and the eastern chipmunk, *Tamias striatus,* have been recorded from the Refuge.

Only two of these small four-inch terrestrial squirrels (chipmunks) have been seen. This pert little animal has a bright rusty to reddish brown coat striped with five blackish bands running from shoulders to rump, and two bright light colored stripes, one on either side of the body. The scarcity of these animals is not unusual; the chipmunk is not a common animal anywhere on Staten Island. This small squirrel, unlike its larger cousin, the gray squirrel, goes into true hibernation, spending the winter curled up in its underground nest. A favored place in which to make its home is at the base of a stone fence where it can find ready refuge from its many enemies (hawks, owls, rats, opossums, cats, dogs) amongst the rock crevices.

The gray squirrel is not common at the Refuge, but, unlike the chipmunk, it is very common on Staten Island. The avenue of escape open to the gray squirrel is the total area of the tree tops. It comes to the ground only to collect and bury nuts. Probably the small populations at the Refuge are a result of scarce food supplies. In addition to nuts, these animals feed upon various fruits and berries, buds of trees and bushes, and perhaps an occasional insect or young bird. Although careful observations have been made, no

definite evidence of nesting has been recorded. The nests are usually constructed in hollow trees or in gatherings of twigs high up in the trees. Mating takes place in mid winter and the young are born after a gestation period of about forty-six days. Squirrels are quite active throughout the entire winter; however, they will curl up in the nest and sleep through periods of inclement weather.

RABBITS

Rabbits are well known for their ability to reproduce rapidly under favorable conditions. Their natural enemies at the Refuge are hawks, owls, dogs, cats, rats, opossums, man, and disease. It is perhaps disease that keeps the numbers of these rodent-like mammals in check. All specimens examined by the author were emaciated and heavily infested with ticks. In this condition they could be ready victims to a bacterial infection. Fluctuations in population densities are evident from year to year, probably because of epidemic diseases. The local cottontail rabbit, *Sylvilagus floridanus,* is a small, fourteen-inch-long mammal which superficially appears to be a large-eared rodent. However, close examination of its dentition shows a pair of incisors in the lower and upper jaws. The upper jaw possesses an extra set of incisors which are without cutting edges and are nearly circular in outline. This and other characters place the rabbit in the order known as *Lagomorpha.*

The typical coloration of our local cottontail is dark fawn brown with reddish tinged fur on the back, grayish sides speckled with black, and a powderpuff-like tail snow white on the underside. The great variety of food (green vegetation, grasses, foliage, bark, etc.) eaten by the rabbit enables it to exist in just about any environment. Although a timid animal, the cottontail is far from helpless. His sudden bursts of speed and his tactic of wheeling back on his tracks, seeking refuge in a dense briar patch, evidently combine to form a good defense.

DOGS, CATS, AND MAN

These are the largest mammals that visit the Refuge.

Both dogs and cats as predators must be taken into consideration if we are to evaluate the total environment of the wildlife populations at the Refuge. Even though dogs are usually responsive to the "easy" life that they find around human habitats, their instinctive desires for the hunt are strong, and dogs that find their

way into the Refuge become a potential hazard to the maintenance of a natural balance.

Cats are even more offensive, their cunning and stealth making them an important enemy to all wildlife. It is the author's view that they should be eliminated from this area by the most effective methods.

The many school children and other visitors who go through the Refuge have a considerable influence upon the distribution of the mammal populations. It is my experience that the less disturbed areas have become more heavily populated.

The pressures caused by man are in many ways subtle and indirect and difficult to measure.

LIST OF MAMMALS

Didelphis virginiana	Common Opossum
Cryptotis parva	Least Shrew
Blarina brevicauda	Short-tailed Shrew
Condylura cristata	Starnose Mole
Scalopus aquaticus	Eastern Mole
Myotis lucifugus	Little Brown Bat
Eptesicus fuscus	Big Brown Bat
Lasiurus borealis	Red Bat
Lasiurus cinereus	Hoary Bat
Peromyscus leucopus	Whitefooted Mouse
Microtus pennsylvanicus	Field Mouse
Mus musculus	House Mouse
Rattus norvegicus	Norway Rat
Ondatra zebethica	Muskrat
Sciurus carolinensis	Gray Squirrel
Tamias striatus	Chipmunk
Sylvilagus floridanus	Cottontail Rabbit
Canis	Dog
Felis	Cat
Homo sapiens	Man

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FOLSOM POINTS FOUND AT ROSSVILLE, STATEN ISLAND

By

ELLIOTT R. BURGHER

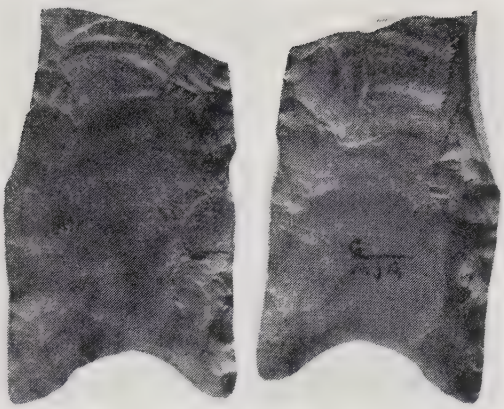
In 1927, when J. D. Figgins of the Denver Museum of Natural History found an arrowhead, a "Folsom point," between the ribs of an extinct bison near Folsom, New Mexico, it marked a turning point in the controversy about the presence of early man in America.

This was not the first discovery of so-called Folsom points. The Smithsonian Institution has a few in older collections, and Koch found one in 1839 under a mastodon. Even though these points were very unusual in shape and were never found in the Old World, little attention had been paid to them by scientists until 1927. During the second half of the nineteenth century, at least eight other localities have yielded such finds along with fossils of extinct animals or other evidence of considerable age.

In the first quarter of the twentieth century many additional finds were made. In 1924 a point was found under a bison at Lone Wolf Creek, Texas, by men of the Denver Museum of Natural History, and in 1926 geologist E. H. Sellards at Frederick, Oklahoma, found artifacts in what he believed to be glacial moraine. These finds were authenticated, but unfortunately general scepticism surrounding the dating of early man had been built up by previous scientific theories about American prehistory.

The find in 1927 at Folsom, New Mexico, changed the attitude of almost all anthropologists towards the dates of the migration of early man. The scientific evidence was unmistakably conclusive. Among authorities accepting this historic find were Barnum Brown of the American Museum of Natural History, Frank H. H. Roberts, Jr., of the Smithsonian Institution, and Alfred V. Kidder of the Peabody Museum Foundation at Andover. They accepted this evidence that man had lived in New Mexico and had hunted animals which were supposed to have been extinct by the end of the Glacial Period.

Photograph A



Photograph B

Anthropologists were off on the trail of more such finds, collecting data to trace the migration of this early man in America.

Twenty-three skeletons of extinct bison were found on the Folsom site. The conclusion was that this was a prehistoric kill. Man had something to do with this; the tail bones of each bison were missing—and hunters will tell you that in skinning "the tail goes with the hide."

The shape of the arrowhead found at Folsom was unique, and for such a primitive culture was beautifully made. It was broad, with a deep concave base that ended on each side with a jutting point or "ear." The edges were skillfully chipped and on some points the base and ears were ground smooth. From the base to about the tip of the point on each side a long flake like a flute or channel made the point look like the end of a bayonet. Folsom points have now been found in nearly all of the States.

A second discovery was made at Clovis, New Mexico, by Howard in 1932. This site was dated by glacialist Ernest Antivs and geologist Kirk Bryan. The finds were made in dried lake beds of the Pluvial Period, dating as early as the end of the last glaciation 10,000 to 12,000 years ago. Fossils of extinct mammals were found—mammoths, horses, peccaries, camels, and bisons.

At Lindenmeier, Colorado, in 1934, Roberts made the third major discovery of classic Folsom points. Again bones of bison and camel were found associated with artifacts. This find was made at an occupational site, a camp of some duration on an elevated river terrace. A geological study linked it with glacial moraines which indicated a readvance of the glacial age.

The actual date of Folsom man is uncertain. The Folsom point proved that early man had hunted animals long since extinct in the United States. Finds of two classic Folsom points—one between the ribs of an extinct bison and another in the channel of a bison's spinal cord—prove this without a doubt.

Scientists point out that the reason we have not found the remains of the Folsom man is that he was a migrant hunter who probably disposed of his dead by leaving the bodies exposed on scaffolds in trees or by cremating them.

There is strong belief that these migrant hunters entered the northeast section of the United States from a southerly or southwesterly direction. Fluted points of consistent features of construction have been found from Alabama to Maine; some have been surface finds and in some instances actual camp sites have been recorded. Certainly these paleo-Indian hunters enjoyed the freedom of hunting for food in as primitive a country as ever existed in the history of man.

New Brunswick, New Jersey, was the place nearest to Staten Island at which a Folsom point hitherto had been found. The migrants could have used the Raritan River to travel to or from Rossville, Staten Island, where the artifacts illustrated were discovered.

The conclusion of scientists is that the northeastern United States, in due course, became included within the hunting range of the paleo-Indians. It is hard to say whether this occurred before or after the fundamental Clovis industry had undergone various modifications in point styling.

Stephen Cuttting of Staten Island found the Folsom point shown in photograph A over forty years ago on the surface in Rossville, Staten Island. After his death his widow, Virginia Cutting, gave his entire collection of artifacts to the Staten Island Historical Society.

On November 4, 1956, Robert Anderson, a ten-year-old boy who lives in Westerleigh, Staten Island, was out with his father hunting for Indian artifacts. Following the ditch that the Standard Oil Company was digging to lay an oil pipe line from New Jersey to Staten Island, he found the Folsom point shown in photograph B. This artifact came from the ditch for the pipe line, which had been cut through a small rise, placing the artifact under eleven feet of glacial outwash.*

* Determination by R. F. Mathewson.

These are the only two Folsom points of record which to date have been found within the New York City limits. They are indeed very important, historical discoveries, tracing early man back to about 7,000 to 10,000 years ago on Staten Island.

CREDITS

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Photographs by Lucie Adams, Staten Island.

BOOK REVIEWS

HANDBOOK OF SNAKES OF THE UNITED STATES AND CANADA, by Albert Hazen Wright and Anna Allen Wright. Two volumes, 1105 pp. Cornell University Press, Ithaca, New York. 1957. $14.75.

"In all our portrayals we have sought to emphasize the living animal . . ." This statement in the preface to the *Handbook of Snakes of the United States and Canada* gives the rule of the authors throughout their work. In the main, the two volumes which comprise this book contain first hand accounts drawn from the multitudinous personal observations and notes collected by the Wrights during many years of concentrated interest in herpetology. I recollect a request for data made by Dr. Wright back in 1934, and I am certain this work was started many years before that. Their personal observations are reinforced by supplemental data acquired from many of the country's outstanding herpetologists. The resulting compilation is perhaps the most thorough, precise, and informative text yet published on the snakes of this country and Canada.

Excellent maps, diagrams, photographic illustrations, and line drawings do much to clarify the many descriptions. The free and friendly style of writing, coupled with a facility to relate scientific data accurately in story fashion, keeps this book from becoming merely a statistical report. In my opinion, many hours of interesting reading are to be found between the covers of this book, not only by the student and professional herpetologist, but also by the lay reader.

ROBERT F. MATHEWSON

COUNTERFEITING IN COLONIAL AMERICA, by Kenneth Scott.* 583 pp. Oxford University Press, New York. 1957. $5.00.

Kenneth Scott has written an unusual and definitive book: *Counterfeiting in Colonial America.*

Probably most of us have known, vaguely, that a good deal of counterfeiting went on here before the Revolution, but I doubt if many besides Mr. Scott have known the extent of these dubious proceedings. There seem to have been hundreds of men and numerous women, too, who manufactured coins and bills in their cellars and attics and secret closets and then managed to distribute this money among the unfortunate public. One regrets to find that in the heat of the approaching Revolution these activities were carried on here and there, secretly, under the encouragement of the British government who considered the depreciation of our currency a subtle and clever weapon of offense—which, indeed, it was. One also regrets to read that counterfeiters were too often substantial citizens who should have known better, but succumbed to the temptation to turn an easy and dishonest penny.

Authorities tried their ineffectual best to discourage all this. Culprits were given staggering fines, which they usually evaded; were clapped into jails from which they continuously escaped. They were put into pillories, were beaten and sometimes had their ears cut off. Now and then they were hung. Mr. Scott says that on one occasion "the rascals were carried off to the gallows singing psalms on the way."

The author has given us a vigorous account of an important, little known problem of our early history. He writes well. Since this book is brought out by the Oxford University Press it is an admirable example of the publisher's art.

THEODORA MCCORMICK DU BOIS

MYSTERY OF THE GREEN CAT, by Phyllis A. Whitney.* Illustrations by Richard Horwitz. 208 pp. The Westminster Press, Philadelphia. 1957. $2.75.

If you are ten to fourteen, or even older, and like mystery stories or those about interesting families beset by difficulties, you will enjoy Phyllis Whitney's *The Green Cat.* It tells about the adventures and problems of the Dallas family, which consisted of Roger Dallas, a widower with two thirteen-year-old sons—amiable Andy and resentful Adrian—and Roger's new wife, Emily Spencer, mother of eight-year-old Carol and twelve-year-old Jill, who tried so hard to help her mother get the twins to be friendly towards them. You will thrill over Jill's and Andy's adventures in the mysterious Victorian house next door where two elderly ladies live in secretive seclusion. You will find out how a green cat with a mysterious message around its neck helps to solve their mystery.

* Staten Island resident.

Phyllis Whitney has again written a fascinating story for young people—one that is laid not only in the picturesque San Francisco of today, but harks back to the historic San Francisco of the terrible fire.

EDNA A. PETERSON

MORE ABOUT BOOKS

Mr. I. C. G. Cooper, Curator of the Davis Collections, had promised to write some reviews for us, including one of E. B. Ford's book, *Butterflies.* We could not arrange for another reviewer after Mr. Cooper's sudden death, and the best we can do is to present to our readers a brief résumé of this and other books which we feel would make entertaining and informative reading, and probably be happy selections for gifts.

BUTTERFLIES, by E. B. Ford. The Macmillan Company, New York. 368 pages. $6.00.

One of the New Naturalist series, this book is beautifully illustrated with 87 color photographs of butterflies life size; 89 in black and white, and 41 maps and diagrams. Originally a British publication and dealing essentially with specimens found in the British Isles, this book is nevertheless of interest to anyone studying butterflies, giving, as it does, much fundamental information applicable to butterflies wherever they may be found—their structure and development, habits, protective devices, genetics, breeding, and evolution.

THOSE OF THE FOREST, by Wallace Byron Grange. The Flambeau Publishing Company, Babcock, Wisconsin. 314 pages. $4.75.

Not a new book, *Those of the Forest* is beautifully written and has been acclaimed by biologists and awarded the 1955 John Burroughs Medal. From a rabbit's-eye view, the reader sees, lives, and struggles for life in the world of Snowshoe, his mate, and their son Lepus, and almost unwittingly absorbs the author's extensive lesson in ecology. The clever conclusion of the book, in which Lepus, ". . . dreaming, ventures forth . . . to hop back through the runways of time . . .," takes us with the Ancient Rabbit from pre-Cambrian geologic time through the intervening ages until a comparatively modern forest fire almost deprives us of our narrator. Lepus—an old rabbit now—awakens again to the October sunshine, but not until he has taken the reader through the years from the time of "a world devoid of animate voices, for upon earth there is, as yet, no life." This is a book without any mention of man in it——and we found it the kind of book one likes to own.

A FIELD GUIDE TO THE FERNS AND THEIR RELATED FAMILIES, by Boughton Cobb. Houghton Mifflin Company, Boston. 281 pages. $3.75.

One of the Peterson Field Guide Series, this book gives detailed descriptions and illustrations of the ferns of the greater part of North America. The order of presentation of the species has been criticized by

some experts, but this does not impair the book's usefulness in identifying the ferns, and identification is simplified by a complete key of silhouettes. A valuable contribution to the contents of the book is a short geological history of ferns by Dr. Theodor Just, Curator of the Department of Botany of the Chicago Natural History Museum.

AMERICAN TENNIS, by Parke Cummings. Little, Brown & Company, Boston. 1957. 302 pages. $6.00.

Staten Islanders particularly should find Parke Cummings' book entertaining. Staten Island is mentioned in the very beginning of William F. Talbert's preface to this profusely illustrated, well-written story of tennis in America. In the book itself, Miss Mary Ewing Outerbridge is given due credit for introducing the game here, apparently without the blessing of custom inspectors who, in 1874, grudgingly permitted her to bring in from Bermuda certain "odd-looking paraphernalia" which was put into use at the "staid Staten Island Cricket and Baseball Club." Mr. Talbert aptly describes this book as one much needed to link "yesterday's delicately-hopping, ball-tapping court heroes and heroines with today's muscled, power-hitting blockbusters." Any tennis lover will have fun reading it. Mr. Cummings has appended the USLTA Records and a comprehensive bibliography.

SKYE CAMERON, by Phyllis A. Whitney.* Appleton-Century-Crofts, Inc., New York. 1957. 312 pages. $3.75.

Phyllis A. Whitney has added another most readable book to her list of successful publications. In bringing together characters of striking contrast, she has worked out a plausible narrative that has variety and suspense, and a conclusion unexpected and satisfying. Her choice of the Old French Quarter of New Orleans as the background for a mixture of Scottish and Creole temperaments has evidently been supported by conscientious research. We found it a sufficiently different novel to be entertaining reading.

THE LOVE OF FINGIN O'LEA, by Theodora McCormick.* Appleton-Century-Crofts, Inc., New York. 1957. 346 pages. $4.50.

Ireland in the twelfth century is the setting for this latest novel by Theodora McCormick. Written with skill and imagination, the story unfolds through characters that run the gamut of an accepted concept of the Irish temperament—turbulent, recklessly brutal, domineering at the one extreme; loyal, tender, and endlessly self-sacrificing at the other—with their troubles in the main the result of their own deeds, involving the guilty and innocent alike. Fingin, as an increasingly successful healer, brings the reader in touch with the high points of interest in those days—the surgeons' college at Salerno, the court of Henry Plantagenet and Queen Eleanor, as well as the lesser courts of the Irish kings. One could wish for a lighter touch at times—but the days were tragic and the scenes sombre or violent, with superstition rather than whimsy a characteristic of that period. Theodora McCormick obviously spared no pains in the research necessary for this book.

EDITOR

* Staten Island resident.

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I. C. G. COOPER (died September 29, 1957)

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MAP OF MAIN AND RICHMOND CREEKS

From: U. S. G. S., Washington, D.

Prepared by the Army Map Service (194

THE ECOLOGY OF FORAMINIFERA OF MAIN AND RICHMOND CREEKS, STATEN ISLAND, NEW YORK

By

HANS J. BEHM *and* EDMUND F. GREKULINSKI

The areas of interest of the authors of this paper, even though their subject matter is closely paralleled, make it necessary to present their findings as Part I and Part II.

INTRODUCTION

THE PURPOSE of this paper is to discuss the ecology of living foraminifera of Main and Richmond Creeks. The distribution of dead tests must necessarily be explained in the light of conclusions drawn from a study of the distribution of living populations. The study is by no means terminated and much remains to be done.

The area is located between North Latitude 40°33′40″ and 40° 36′ 10″ and West Longitude 74° 09′ 00″ and 74° 12′ 40″. Roughly, its boundaries are the Arthur Kill, Carteret and Woodbridge in New Jersey to the west; Victory Boulevard and Travis to the northwest; Bull's Head to the north; Arthur Kill Road, Eltingville, and Arden Heights to the south. The region rests on glacial outwash southeast of the southernmost extent of the serpentinite.

The vast network of creeks receive marine water via Arthur Kill (which in turn is fed by Raritan Bay and Lower New York Bay) and via Kill Van Kull, from Upper New York Bay. Two small freshwater streams feed Main Creek north of Signs Road. Richmond Creek receives fresh water from the serpentinite hills in Richmondtown. The vegetation along the creeks and in the marshes consists of several species of *Spartina* and *Phragmites.* (For a more thorough description of the flora, see *Proceedings of the Staten Island Institute of Arts and Sciences*, Volume XIX, Number 2, Spring 1957.) Lake Island (Island of Meadow) acts as a natural barrier and considerably affects tidal movements.

Much of the region adjacent to the mouths of Fresh Kills, Richmond, and Main Creeks has been filled with refuse by the Department of Sanitation of the City of New York. Eventually the whole area is to be so filled. A tide gate is to be erected at the mouth of Fresh Kills in the near future. This would cut off the supply of marine water, thus converting the major creeks into a freshwater lake, which would possibly exterminate the present living populations of foraminifera and would change the character of the flora and fauna of the region.

A few samples of sediment were collected as early as October, 1953. The first organized investigations began in the summer of 1954. The first living foraminifera were found in the late summer of 1955.

The waters of Main and Richmond Creeks are essentially brackish, but near-freshwater conditions are found at the heads of the smaller tributaries and ditches of the major creeks.

PART I—ECOLOGY

By

HANS J. BEHM

A VARIETY of tide pools of all depths and shapes are found at low tide, particularly amid spartina, in the marshes of Main and Richmond Creeks. Some tide pools are only a few inches across; others may be several feet across. Their depth may vary from a few inches to a foot or more. The tide pools are conditioned by both their topographic setting and the vegetation of the region. At low tide, stagnant conditions are the rule. The rich and varied aquatic flora is composed of filamentous algae, unicellular algae, and diatoms. Some algae form a brown mucilaginous scum on the leaves and stems of spartina. Some diatoms are epiphytic on the leaves of spartina; others form a greenish scum along the edges of the creeks. Algae in the tide pools are well adapted to such stagnant conditions. Little circulation takes place at low tide, and much evaporation and the influx of fresh water contribute to a great variation in salinity. Spartina grows along the edges of the creeks, mud banks, and clay banks of the marsh. A rich and varied fauna, consisting of foraminifera and other protozoa, ostracodes, and other invertebrates are found in tide pools and smaller creeks of the marsh. The foraminifera largely consist of arenaceous

forms. In the early ontogenetic stages they are chitinous for the most part. Testacea are common. Ostracodes are confined to the smaller creeks and tide pools. The diatom flora is rich and varied in both the tide pools and the smaller creeks. The black decomposing organic muds at the bottom of the creeks contain a limited fauna of invertebrates. The ribbed mussel, *Modiolus demissus plicatulus*—Lamarck, is found in profusion along the clay banks of the creeks.

Continued observations show that most living foraminifera have a commensal relationship with the algae. Repeated observations indicate that most living specimens select unicellular algae and diatoms for food. Selected laboratory specimens usually attached themselves to filamentous algae. The foraminifera were so firmly attached that it was difficult to remove them. Moreover, the algae help to keep the foraminifera off the immediate bottom. Experiments showed that foraminifera were killed if they came in contact with black organic ooze. In most cases, living specimens spent a considerable amount of energy searching for food. Few living specimens were slow and sluggish. Most specimens would gather anything within reach; nevertheless, they are selective, often discarding unwanted debris and ingesting unicellular algae and diatoms. A few living forms were recovered from algae attached to floating wood, spiles, shells, or submerged objects.

The following foraminifera were collected (see Plate on page 57):

MARSH FACIES

Trochammina inflata
Trochammina comprimata
Trochammina macrescens
Jadammina polystoma
Arenoparella mexicana
Recurvoides sp.
Miliammina fusca
Miliammina sp.
Ammoastuta inepta
Ammoastuta salsa

ESTUARY FACIES

Rotalia beccarii
Ammobaculites exiiguus
Ammobaculites dilatatus
Ammobaculites salsus

Examination of the fine residue from samples collected at the heads of Main and Richmond Creeks showed many chitinous linings. These were compared with the early ontogenetic stages of the larger forms. The chitinous linings were found to belong to the early ontogenetic stages of arenaceous foraminifera such as

Trochammina inflata, Trochammina comprimata, Trochammina macrescens, Arenoparella mexicana, and *Ammobaculites*—sp. Most of the samples collected consisted of an assortment of algal and bacterial scums, filamentous algae, and stems and leaves of spartina. Upon microscopic examination, they were found to contain, in addition, healthy populations of protozoa and diatomaceae. To what degree pollution may affect the fauna and flora of the marshes is as yet difficult to ascertain. There is increasing evidence that some protozoa and microscopic plants actually thrive on some of these waste products. Ironically, some of the refuse may produce nutrient solutions upon decomposition. The protozoa were found on the algae, on organic scums lining the shores of the smaller creeks, and in tide pools. Undoubtedly, the whole community of plants and animals plays an important part in the balance of conditions within the marsh. Solar radiation, temperature variation, seasonal fluxes, salinity variation, and behavior of tidal currents are some of the factors which have an important place in the establishment of given ecologic habitats. Since brackish-water foraminifera appear to be less sensitive to environmental changes, their use as laboratory specimens is decidedly advantageous. These foraminifera are capable of adapting themselves to changing conditions, particularly to changes in salinity and temperature. No "dwarfed" faunas were found in the collections made. Specimens were collected over a period of several years in the restricted areas of the marsh, but the specimens examined were large, vigorous, and healthy.

The summer of 1957 had abnormally low precipitation. The salinity of the water within the smaller creeks was 12,000 parts per million, as of October 3, 1957. Normally, the salinity ranges from 6,000 to 8,000 parts per million in this locality. *Rotalia beccarii,* normally found associated with *Zostera* along the coast of the Lower New York Bay, was found thriving in the tide pools. Previously, no living specimens of *Rotalia*—sp. were found.

Black, hydrogen sulphide laden decomposing muds are found in the deeper channels of the creeks and ditches of the marsh. These muds can only form in places where there is little wave and current action. Where the waters are subjected to wave and current action, the bottom is usually composed of silt or sand. Little organic debris is found here. Marcasite is usually associated with the black muds. Some glauconite was found. Whether the glauconite was formed *in situ* or transported is difficult to interpret.

PLATE EXPLANATION
(Photomicrographs in Phase)

Fig. 1—*Trochammina inflata* (x 200)
Fig. 2—*Trochammina comprimata* (x 200)
Fig. 3—*Trochammina macrescens* (x 200)
Fig. 4—*Arenoparella mexicana* (x 200)
Fig. 5—*Recurvoides* sp. (x 200)
Fig. 6—*Rotalia beccarii* (x 200)
Fig. 7—*Miliammina fusca* (x 300)
Fig. 8—*Ammoastuta inepta* (x 200)
Fig. 9—*Ammobaculites salsus* (x 150)
Fig. 10—*Ammobaculites* cf. *dilatatus* (x 200)
Fig. 11—*Ammobaculites exiiguus* (x 250)

Where current action is very strong, the sediments are generally coarse to very coarse. Current and oscillation ripple marks may be seen along shallow stretches of the shores at low tide. Little vegetation grows within these sandy stretches. No living populations of foraminifera were found here, except for a few broken or fragmental tests. Oxygenation, brought about by photosynthesis in algae, and the churning of the waters are essential to the living foraminifera. Nevertheless, excellent and well preserved death assemblages are often found within these muds. The dead tests are sorted according to size and weight. Dead tests of foraminifera filled with air on exposure may be carried downstream for considerable distances. Current and wave action will transport and sort the tests. These may be well sorted or poorly sorted. Population counts made on such samples are not truly representative of those made on living populations. If accurate statistical analyses are desired, the foraminifera must be collected in the live state; representative algae and other plants must be collected, the foraminifera then killed, and counted. Once the foraminifera die, they are subjected to differential sorting. Some tests may quickly dissolve upon death of the animal, whereas other tests are more resistant to the wear and tear of transporting agents. The best preserved forms are generally found in black organic oozes; i.e., in the quiet depositional environment of the marsh.

Living populations may shift their habitat as the flora changes. These changes may be induced by several factors, particularly seasonal fluxes, salinity changes, and temperature variations. Severe storms, such as hurricanes, gales, thunderstorms, and abnormally high tides, may profoundly influence the distribution of organisms in the marsh. A hurricane, combined with unusually high tides, will not only bring about great changes in the sedimentary pattern of the marsh, but also abnormal shifts of faunal and floral communities, though only temporarily so. Excessive evaporation during the hot summer months and a lack of precipitation will increase the salinity considerably and so produce marked changes in the distribution of living populations. The introduction of chemical waste products from industrial areas may prove disastrous to many plant and animal communities. A very rainy season may reduce salinity to such a point that migration of fauna may take place in a downstream direction.

The size range of the arenaceous foraminifera of Main and Richmond Creeks is from 20 to 500 microns, depending on the

genus and species or whether the specimen under study is neanic or fully matured. The genus *Ammobaculites* is the most coarse-grained. The genus *Trochammina* is finely to very finely arenaceous, with one species almost completely chitinous. The genus *Ammoastuta* is very fine-grained. Most genera have an inner chitinous lining. The early ontogenetic stage is largely chitinous, with little or no trace of arenaceous material. After death, most chambers of the chitinous stage collapse and appear deflated. This is so in specimens of *Trochammina macrescens* and *Jadammina polystoma*, both of which consist almost exclusively of chitin. In the early chitinous stage the proloculum may be triangular, square, or polygonal in outline. This may be due to the pressure of the overlying chambers in the next whorl. As it is very difficult to ascertain the true nature of the early ontogenetic stage of live foraminifera, one cannot be sure whether the chambers appear deflated, as is the case in slide preparations. However, increasing evidence indicates that the proloculum and succeeding chambers are rounded and inflated. When observed in reflected light, the living specimens are characterized by a beautiful golden and amber-yellow color, which the dead tests lack. In transmitted light they are almost completely opaque, showing a faint deep red brown. Dead tests are more or less transparent. *Rotalia beccarii* is a beautiful golden yellow when observed in reflected light. In transmitted light, the chambers are opaque; but light is transmitted along the planes of contact of the different chambers and along the sutures, thus delineating each individual chamber. Non-living *Rotalia beccarii* is almost completely transparent. Impurities due to ferruginous material, organic matter, or other foreign substances may obscure detail in transparent tests. The resistance of foraminiferal tests to the agents of transportation is differential, and varies greatly in the different forms. *Trochammina macrescens* and *Jadammina polystoma* (largely chitinous) are the most resistant. *Trochammina inflata*, *Trochammina comprimata*, *Arenoparella mexicana*, and *Recurvoides* are a close second. Most species of the genus *Ammobaculites* are particularly susceptible to disintegration. The ability to withstand disintegration probably is a function of the amount of a very resistant chitin. How selective some of the forms are in gathering grains for building their tests is difficult to ascertain. However, most of the genera studied show instinctive ability to discriminate between different grain sizes. As to compo-

sition, most forms select grains of quartz, magnetite, tourmaline, mica, and even diatoms. Some forms have incorporated eroded fragments of glass derived from dumping operations within the marsh. The incorporation of magnetite is particularly high in species of *Ammobaculites,* and may be so abundant at times that the specimens can be concentrated with the aid of a powerful magnet. *Rotalia beccarii* is calcareous hyaline. Some arenaceous tests are covered with a bloom of finely disseminated crystals of marcasite. Some specimens have been found to be completely replaced by casts of marcasite. As yet, no casts of glauconite after foraminifera have been observed.

It is fascinating to watch the life habits of a foraminifer under a microscope. When cleaned of the debris with which most forms cover themselves, sooner or later they will emit an extensive network of anastomosing pseudopodia, via the aperture in the arenaceous foraminifera, and via both the aperture and test perforations in *Rotalia* sp. The animal will either stand erect or on edge with the aperture down and crawl leisurely along the bottom, dragging along its test. A vigorous flow of granular cytoplasm may be seen in the pseudopodia. Two-directional streamers of cytoplasm may be seen in a single pseudopodium. The network of pseudopodia may be so extensive as to give the appearance of a halo around the test. Little by little the foraminifer gathers diatoms and small algae until it completely surrounds itself with a ball of food. This makes uninterrupted observation of the living animal extremely difficult and necessitates frequent cleaning of the specimens with a fine camel hair brush.

Living foraminifera may be collected from a boat or from the shore line. As many of the forms live in tide pools, accessibility becomes less of a problem. The foraminifera are concentrated by washing quantities of *Spartina* sp. and algae in a plastic container. The concentrated residue is screened through a plastic sieve to get rid of larger plant constituents and metazoa, as they may pollute the sample. Next, the residue is decanted with sea water several times to insure a clean sample and lessen the changes of impending pollution. As the foraminifera are very hardy it is not necessary to transport them in thermos jugs. The sample may be distributed into several one-pint wide-mouthed jars and covered with plastic

caps. Care must be taken not to crowd the samples since this may kill the algae and cause putrefaction. Once in the laboratory, the samples may either be kept in the original collecting jars or be stored in four-inch finger bowls and covered with watch glasses to prevent evaporation. The samples may be stored near windows with a southern exposure, or, if no satisfactory daylight illumination is available, 14-watt daylight fluorescent lamps may be provided.

PART II—PALEOECOLOGY

By

EDMUND F. GREKULINSKI

PALEOECOLOGY is the ecology of organisms in the geologic past, an interpretation based on the studied relationships of modern plants and animals to each other and to their environments. Micropaleontology is the study of minute fossils or small parts of minute or larger fossils, as classifiable entities in themselves. Aquatic paleoecology is intimately bound up with sedimentary processes, since the final distribution of organic remains (later to be studied as fossils) depends on wave and current action in the body of water. As a result, the geographic distribution of the fossils may not correspond exactly, or even at all, with that of the once living organisms. Furthermore, as the environment of a particular area changed through time, a vertical succession of different life groups, each adjusted to a different ecology, may very likely occur. These factors are significant for even such a relatively short interval of geologic time—late Pleistocene (sub-recent)—as represented in Main and Richmond Creeks, for the distribution of the living foraminifera here would be an effective check on the distribution of the dead and empty shells. The latter distribution depends on: (1) sedimentary rearrangement; (2) a past ecology different from the present one; (3) on both of the foregoing, or (4) on none of these possibilities (i.e., no change of any kind).

The requirements for correlating or equating beds or rocks of equivalent age in geology and the requirements for paleoecologic restoration are in a sense opposed. Effective stratigraphic correla-

tion depends on geographically widespread index fossils ranging throughout many environments but restricted in time vertically; paleoecology, on environmentally restricted fossils with unlimited vertical (time) range, which are still in place. A particular area may have a static environment, or at least some of the organisms therein may be so tolerant that they remain despite changes in ecology, with no apparent changes of any kind in the sedimentary and fossil record. In other words, environmental alteration may or may not be reflected in the nature of the rocks and in the fossil population, or in either one of them. Aquatic sedimentary processes must be taken into consideration. This is particularly difficult where bodies of water no longer exist, and only indirect evidence is at hand from which to draw deductions.

Sedimentary displacement or reworking is highly crucial in the study of microscopic fossils or "microfossils." It is of paramount importance even in apparently stagnant waters, for fine particles are shifted by even slight movements. Crude sampling methods may disrupt "micro-environments" and "microgeographies," mixing up microfossils that were actually separated by many years, even centuries, of time. A particular microfauna at a particular time level or horizon may represent: (1) a wholly native group (*in situ*); (2) a group transported there from elsewhere; (3) both elements, native and foreign. If these displacements were slight, occurring within a single definite ecologic area or a biogeographic province, there is little problem in interpretation, except at the finest levels. Such reworking as takes place during the time of deposition or slightly later is called "penecontemporaneous." Later redeposition of beds by streams after the body of water where they were deposited has become land may be far more serious in its consequences for geochronology. Criteria for judging the presence and degree of reworking are based not only on the physical condition of the fossils (degree of wear or disaggregation), but on the sorting by weight, size, and shape. Well sorted remains may indicate working over and transport by currents so that bodies of equal weight are put together. Poorly sorted remains, composed of ill-assorted aggregations of bodies and parts of unequal sizes and weights, may indicate little or no displacement, or indiscriminate transport and dumping by powerful currents, or different periods of deposition characterized by different intensities of carrying forces, bringing to the same place successively sediments of differ-

ent fineness and density. The condition of the fossils is important here, as well as classes of size and weight and their relative proportions, as determined by sieve analyses.

Remains, however, may be disintegrated by scavengers, decay, or corrosive water elements—a fossil site may be a cemetery rather than the former residence, so to speak. Even mild environmental influences, when operating over a great length of time, may produce significant changes, which may pass unnoted by the untrained eye. Last, but not least, is the factor of size and weight of organisms as determined physiologically *in situ*—by the direct action of the physical and biological environment in terms of available food and oxygen supply, by the indirect effect of the environment in its selection of organisms for survival having a certain optimum size as determined by genetic inheritance, and by genic mutations causing significant growth rate and consequent size changes. Distinction must also be made between adult and juvenile forms in a species, particularly in those, such as foraminifera, that are characterized by distinct growth stages and life cycles, with morphologic traits peculiar to each. Birth and death rates are important, too.

In a sense, paleoecology and evolutionary science are in opposition, in that the former tends, in general, to render static the ecology and the environmental needs of organisms. This particularly facilitates the interpretation of past environment, in the light of modern ecologies, whereas the latter study is rooted in the concept of change. But this opposition is less real than it at first seems, for: (1) environmental demands of conservative organisms (so-called "living fossils") may change little through even vast lapses of cosmic time; (2) certain community groups persist in particular kinds of environment and, even if elements in both change, certain types of organisms, or particular morphologic-anatomic types, remain characteristic of certain ecologies; (3) given broad climatic-geologic changes, major organic groups may likewise adapt gradually, the net result being little outward change or no sudden radical mutations, or a developed tolerance for varying conditions on a local scale; (4) evolution and ecology work hand in hand, for the geographic separation of populations enables genetic changes to work in isolation, thus giving rise to new species. The further back in geologic time we go, the less reliable are living forms as standards for paleoecology.

We thus have emerged with two major concepts: (1) the stratigraphic index fossil, ideally with a narrow time range and with a broad lateral or geographic range, independent of local ecologies—often an open-sea or planktonic organism; (2) the environmental index, ideally with a great time range and restricted environmental range (not necessarily geographically restricted, for if the environment shifts its geographic locale and the change is not too rapid for the environmental form to follow it, the index migrates with it). Most fossils are seldom so ideal and often fall between these two extremes. Thus we get stratigraphically and environmentally restricted forms, and those that persist through long periods of geologic time and are found in several environments, being of interest from the strictly paleontologic point of view. Whether these geographic distributions are due to the life habits of the fossils, or their redistribution, is a further problem. In addition, we have forms that are partly planktonic, partly bottom-dwellers, in their life cycle, and so may be widely distributed despite favoring a particular environment. Many apparent evolutionary changes in life forms turn out to be due merely to ecologic succession, with forms leaving an area and being replaced by others, or remaining although changing in outward form (so-called "ecophenotypes") to suit the new conditions, reverting, however, to the old shape when conditions change back or anew. Genetically, they are the same, unchanged organism.

Brackish-water life is usually a mixture of freshwater and sea forms, generally not so abundant as in the streams or in the sea. Many scientists hold that there are no such things as peculiarly brackish-water creatures, but, instead, a heterogeneous mixture, as described just above. This may be true of broad groups; but there are species of foraminifera, even genera, that primarily inhabit brackish waters and are so characteristic of them that they may be termed "brackish-water indices." In fact, this habitat is so distinctive that overall climatic change has no effect, the identical species in nearly the same proportions and ecologic niches generally being found from New England to the West Indies. They also occur in the more recent geologic past and so are ideal brackish condition indicators for younger pre-modern deposits. For a marine form to establish itself in shallow, brackish water, it must contend with the following: (1) great inflow of water into its body due to the now less saline water surrounding it; (2) more sudden changes in

environmental conditions, such as salts, oxygen, temperature, etc.; (3) salinity variations particularly, above and below, generally below, the normal marine percentage. A freshwater form entering a brackish environment faces similar problems, although it may be more tolerant of environmental changes, since freshwater environments are less uniform than those of the sea. Also, it would have to keep from losing its internal fluids to the now saltier surroundings of brackish water, as well as cope with perhaps different dissolved salts and proportions of salts in these waters.

In Richmond and Main Creeks, besides the shifting changing local conditions of the present day, there must have been generally different environments at various stages in the recent past—during the Ice Age, when the sea level was lower and the creeks less salty, and in the warmer interglacial and post-glacial times, when the sea rose and flooded the creeks, making them more salty. Furthermore, there is now the effect of human industry with its pollution of the water, particularly further downstream, near the mouth, where live foraminifera are absent; and in the future the installation of tide gates will bar the sea and gradually render the creeks fresh. Will the foraminifera die off or gradually adapt to the fresh conditions? In certain freshwater wells in the Central Asian desert living foraminifera are found, generally similar in form to marine types. Apparently they are relics of the time when these now fresh waters were part of a sea and the foraminifera alive therein; when the sea was cut off from the ocean, the waters freshened and the foraminifera adapted.

The final solution would be to use coring devices to sample the older deposits underlying the creek bottom—a very difficult undertaking given the oozy substratum and the expensive equipment required. At present, as described in the first part of this paper, the live foraminifera are confined mainly to the upper reaches of the creeks, particularly to the pools and fresher creeks. Dead shells occur in the foul oozes of the larger channel bottoms and the creeks proper, where they have been carried from the life centers. In the main, the areas characterized by certain foraminiferal assemblages are distinct, much as described in the coastal regions of Massachusetts and Texas. Some mixing of these two major domains (marsh creek and more saline open creek facies) occurs in the dead shell "populations" in the major creek bottoms and less often in the more marshy areas—which underscores the importance of studying distribution of living forms.

CONCLUSIONS

The rich and varied aquatic flora of Main and Richmond Creeks is composed of filamentous and unicellular algae, and diatoms. A rich and varied fauna consisting of foraminifera and other protozoa, ostracodes, and other invertebrates is found at the heads of Main and Richmond Creeks, tributaries, ditches, and tide pools of the marsh. The foraminifera largely consist of arenaceous forms. In the early ontogenetic stage they are chitinous for the most part.

Continued observations have shown that these foraminifera have a commensal relationship with the algae. Most foraminifera feed upon unicellular algae and diatoms.

Examination of the fine residue from samples collected at the heads of Main and Richmond Creeks shows numerous chitinous linings. These, compared with the early ontogenetic stages of the larger forms, were found to be the earlier stages of the arenaceous foraminifera common to this locality. Dead shells occur in the foul oozes of the channel bottoms of the creeks, where they have been carried from the life centers. In the main, the areas described are characterized by certain foraminiferal assemblages, much the same as those described in the coastal regions of Massachusetts and Texas. Some mixing of the two major domains (marsh creek and more saline open creek facies) occurs in the dead shell "populations" in the major creek bottoms and less often in the more marshy areas—which underscores the importance of the study of the distribution of living foraminifera.

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TWO BOYS AND A BARRED OWL

By

HERBERT WHEATON CONGDON

THE BOYS have grown up. The calendar says they have grown old; but, as that is a matter of definition, it is debatable. The birds of their present generations find that Staten Island has changed, sometimes for the worse. Open fields and bits of woodland have diminished, making it hard to find suitable nesting sites. However, the old Natural Science Association, once housed in the attic of New Brighton's Village Hall, has become the Staten Island Institute of Arts and Sciences with its own offices, a Library and a Museum. Fine buildings; but no longer is a college freshman asked to be Curator of Collections, as I was!

One of the boys lived on a 36-acre estate bounded on its north side by a quiet street, called on the map in Beers' Atlas (1874 Edition) Hamilton Place, from the big residential Hamilton Park on the other side of the street. This home of *Harry's, this estate, this Principality in my eyes, was filled with untold treasure of birds, migrant and resident, living under conditions that must have seemed ideal to them. A long, tree-lined drive led from the street to the old stone house, this avenue merging in places into the belt of woods surrounding the entire acreage and in part passing old lawns, shrub-dotted. Behind the house, which stood in the center of the place, was the wreck of an old formal garden, complete with box hedges and greenhouse. The largest patch of woodland lay in the southeast corner of the land, which fell sharply towards the south, affording a view of the wooded hills beyond. What a place for the various members of the sparrow family, for the warblers! And in migration time, the number of species of course increased amazingly. Once, we saw a tremendous hawk migration pass overhead—a loose column that must have been more than fifteen miles

* Harry L. Beadel, who now lives near Tallahassee, Florida.

long. Through our glasses we could identify a number of species fairly well, some known to us, some new, like the bald eagle in lonely majesty among his humbler cousins.

Each of us owned Dr. Elliot Coues' *Key to North American Birds,* which I still think is the best bird book for the serious amateur in ornithology, even though I have a fairly large collection of other authors' works. How we did study Coues' *Key!* If we had given half as much mental energy to our school books we would not only have graduated from school with honors, but would have formed study habits that would have helped us in college. But we didn't—and they didn't.

For those who do not know this remarkable book I would mention that the introductory sections were, to us, the Law and the Prophets. One section covers field work. From it we learned (and later, practiced) proper registration and labeling, taxidermy, and approved methods for collecting and caring for nests, eggs, and bird-skins. We were able, therefore, to use approved methods from the start for our collections. Both of us owned excellent shotguns, and loaded our own ammunition. This permitted us to fit the loads to the needs of our collecting. We seldom damaged a specimen, and hardly ever lost a wounded bird. Eggs were carefully and properly drilled, each one measured accurately, and measurements and other pertinent data recorded. Similar care was taken with bird skins. Important or significant dimensions were put on the labels, together with date and place of collecting and, as far as our limited knowledge of botany and entomology permitted, the stomach contents noted. This was no wasteful boyish fad; we had our ideals—for which Dr. Coues' book was largely responsible.

Another section of the *Key's* introductory matter was a brief survey of the history of birds, commencing with early fossils of those queer creatures that were neither lizards nor birds— a fascinating study. The section on the anatomy of birds, especially as it showed adaptation to living conditions of the different families, led us to dissecting some of our specimens. To a fledgling architect the construction of a woodpecker's skull was a revelation and an amazement; and the form and placement of an owl's eyes was no less fascinating. Of course the explanatory paragraphs of Dr. Coues' "Artificial Keys" were of the most practical value to us as

we felt our way through the thorny paths of bird-identification. My "Coues" was given me in 1892 and is tattered and worn with use. While today's marvelous pocket *Guide* by Peterson is invaluable to beginners and more advanced students, I do not know any ornithology now in print that equals my favorite or that is more comprehensive. No, not even that godsend to us Yankees, Forbush's three-volume work on *The Birds of Massachusetts.* This has pages and pages of delightful chitchat on the species and splendid illustrations; but it is now out of print—a jewel for the wealthy. Maybe Coues also is out of print; the last time I bought one I found it had grown to a two-volume edition, up to date but not cheap. It is not a book for those who are content to know "a crow from a crocus."

With all this seething interest, we were overjoyed when our good friend Arthur Hollick, a stalwart of the N. S. A. (as we rather flippantly called the Natural Science Association), told me that in the previous year he had collected a clutch of three eggs of the barred owl in the Willowbrook woods. He gave me a map and suggested that I take a look there. We made our plans immediately for a real expedition. Harry was the methodical member of our partnership, and that which follows is taken from his diary, with a little expansion based on my vivid memories of a wonderful day. I conferred with him, and he came to my home at 64 Davis Avenue through a wet snowstorm, where we had supper and planned for an early start the next morning.

"Saturday, March 14, 1895. Mr. Congdon woke us at 7 A.M. We hustled into togs; flannel shirt, knickers, heavy stockings, stout boots, sweater, old coat. Breakfasted, armed ourselves. HWC with shotgun and bowie knife. I had climbing irons and a tin box with leather strap which H. insisted on calling a Vasculum. It was borrowed from his older brother Ernest, without his consent, of course, as he wasn't home. Started on our Treasure Hunt at 8:10 A.M., the precious map in my pocket. Full of enthusiasm, we sloshed through the four inches of new fallen snow. Day overcast but gave promise of clearing. Air was bracing even if tainted with smell from the oil refineries across Kill van Kull that always seem to try to spoil a nice northwest wind. Trying to look like dignified scientific collectors, we walked south on Davis Avenue, west on Hender-

son, between the Pelton farm fields to Bement Avenue. Turned south up the hill, crossed Castleton Avenue, pausing briefly to enjoy the wide and beautiful view northward to the Kill van Kull and across flat Jersey to the distant blue Orange Mountains on the far horizon. Bement Avenue soon came to an end, after passing the one house, the Presbyterian Parsonage, and we found ourselves on the wide expanse of The Common, open land dotted with clumps of bushes. We looked with faint interest at some rabbit tracks and saw a few ordinary winter sparrows. From the crest of the hill we looked across the sparsely settled valley to the wooded rise on the other side. We swung diagonally down to the Clove Road through open country, "real country" indeed with hardly a house to be seen. When we got to Clove Lake we crossed on the dam and struck up the hill through the woods and down the other side, across open fields to the small, squalid village of Four Corners. Here we cut past a little schoolhouse and came out on the Turnpike. We walked westerly on this until we reached Willowbrook Road, which we followed towards the south until it bent to the left. Beyond this we saw a house, the landmark of Hollick's map, with a line fence just beyond it. Now we kept the "treasure map" in hand, and turned to our right, following this fence westerly through cedar woods that got thicker, and turned into real forest. Here we found the wood road shown on Hollick's map and turned southerly on it until we reached *the* brook. So far, so good.

"We were in rather open hardwood forest of beech and oak with a scattering of other trees with a healthy crop of young saplings among them. We were well away from 'civilization' and began to slow up and hunt for *the tree* which the map showed just a little way beyond the brook. We failed to find it, so kept on slowly, looking as well as listening for any hint of bird life. No luck. Kept on and found a *second* brook. About thirty yards beyond the somewhat flimsy bridge across this, at 9:50 A.M., we found a tall, slender red oak with a hole in it, high above the ground and yet below the first limb. The tree *looked* slender because of the height of the first branches; it measured a little over two feet in diameter at breast height. Rather alarming for using climbing irons which would fit a telegraph pole nicely but presented difficulties on a big tree. The jagged hole in which the nest was supposed to be was between thirty and forty feet above the ground.

It had rotted out from the scar left by a big limb falling off. This had been the lowest one. There were not even small branches between the hole and the ground and the lowest limb was well above the hole.

"Pacing it off, we found the tree was about forty-five feet to the left (easterly) of the road, and, while there was a nice cover of snow, it did not look like a pleasant place to fall on. Looked for climber marks. Found none; but when I struck the tree lightly the old owl flew from the hole on silent wings and lit in a tree about sixty yards away. She seemed to take little interest in us and soon flew off out of sight and we did not see her again.

"Did a bit of prospecting, HWC looking on with awed interest. Bark hard and reasonably (unreasonably?) smooth. Tried shinnying. No good. Tree too big. Put on climbing irons and started up, feeling very nervous. The ground looked hard. The hole seemed to be slipping up the tree, farther and farther away. Had unpleasant recollections of last week's lecture and classwork on the Theory of Momentum and calculation of the speed of falling bodies. This was not comforting. Also, this was my very first climb with irons and I was soft after several months of college work without exercise. Almost sorry that Hollick had suggested the expedition.

"Reached hole. Three eggs visible, on bedding of cedar bark shreds. Fingers and forearms aching. Tree bulged out at the hole so it gave me little hold. Thought I would have to let go. Thought of angular rocks around base of tree. Called to HWC that I might have to come down without the eggs, unless I fell down first. He was critically enjoying the performance with a foolish grin on his face. Evidently did not realize how my wrists felt.*

"I hung on the edge of the hole with one hand, wiggled the fingers of the other. Changed my mind about leaving those eggs. HWC's fishing reel was in my pocket, the end of the line tied to his mittens so I might lower the eggs in them. The idea seemed to have been that we might save the eggs even if not me. The mittens had slipped beyond the reach of my hand and I could not reel them

* *Author's note:* As a matter of fact, I was in abject terror. The grin must have looked foolish. Anyway, it was forced. I wondered what I would do, could do, if he fell!

up with one hand, so I put the eggs in my coat pocket, wedging them in with my gloves, and began the descent.

"It was harder than climbing up, for I was aching all over and very tired. If the old bird had come back and struck at me as the books say they sometimes do, I would surely have let go and dropped! As it was, I puffed hard, dug the irons in with determination (and increasing hope) and came slowly down resting several times by stretching my hands out straight, gripping with my arms only. That gave some relief to fingers and hands. I reached terra firma safely after what seemed a long time, and breathed a sigh of relief. Showed the eggs to HWC who was quite enthusiastic. He put on the irons and tried climbing on several smaller trees while I recovered my breath and my poise and made a sketch of the tree. I still have that sketch and the eggs also. HWC came back from his climbing experiments and looked pretty solemn. Had gained sympathy for my difficulties.

"At 10:50 we started back, spirits rising as tensions faded, caterwauling war songs, doing Indian dances and discussing how scared we both had been. A glass of very poor beer in a hole of a saloon near The Corners made me feel tiptop. Got a lift towards home from a German farmer who set us down at the Crystal Water Co.'s reservoir with rested legs. The snow, now melting in the sun, made walking slippery and tiring. In my pride, I mistook a song sparrow for a winter wren and HWC shot it for his collection, on the strength of my identification. Much grieved, we gave it decent burial in the snow and he wrote a Latin epitaph. Hope his grammar was better than normally. Reached the Congdon house about 12:30, feeling at least ten feet tall. Spent the afternoon writing up the record and this diary and blowing our three eggs. Incubation had just begun in two of them. The third was fresh. That may account for the parent bird showing so little interest in our raid.

"The nest was only about eight inches below the lip of the hole which is about seven inches wide and six high. There were a few bird feathers on the shredded cedar bark base, but none from domestic fowls. While the nest-tree is not far from the northern boundary of these Willowbrook woods, they extend southward five or six miles and appear to be about a mile wide. An unbroken

block of forest, with a few wood roads in it and several small brooks."

That is the end of Harry's story. The following year we went back again. This time, in addition to the climbing irons, Harry had a stout leather trunk strap which he buckled around the tree and his body so he could rest his arms by leaning back on the belt; a very great improvement for such a climb. He went up the tree, and again secured a clutch of three eggs, which he gave to me for the start of my egg collection—which never grew. I moved to Brooklyn in 1896, however, and seldom went back to these woods. I did go on one snowy January day, a day of brilliant sunshine, deep blue sky and a lot of snow. I saw no signs of life around the nest tree, but as I walked farther along the road I spied a black spot ahead of me, on top of a little bridge. Reaching it, I found a dead saw-whet owl, wings spread as if in flight, lying face down on top of the snow and frozen stiff. When I made it into a bird-skin and opened the stomach I found it completely empty. There was no sign of any lesion, and from the wasted muscles I concluded the poor little thing had starved to death, and had fallen in flight in his last search for food. The old woods seemed unchanged, the neighborhood unaltered except for some large Government building* at the northwest part of the forest. This was about 1910 or earlier. I am afraid that if I followed the path Harry and I travelled on that March day in 1895 I would find changes that would sadden me.

I prefer to remember it as it was.

Unfortunately the barred owl has not been known to nest on Staten Island for many years. The last mention of it occurs in Volume VI of the Proceedings, where Mr. Carol Stryker reported that on March 21 (1931) Mr. Milton Horn had visited a patch of woods near Bull's Head where Mr. Ellison had heard the barred owl on February 28, and "likewise heard the owl." — Ed.

* This probably was a building at the Farm Colony, which seems to be the only large structure in the area at that time.—Ed.

CHRISTMAS BIRD COUNT

On December 22, 1957, 20 observers, working all day, counted 95,545 individual birds and noted 75 species. The list follows:

338 Horned Grebe
1 Pied-billed Grebe
1 European Cormorant
14 Double-crested Cormorants
1 Great Blue Heron
20 Mallard Ducks
199 Black Ducks
1 Redhead
15 Canvasbacks
5,842 Greater Scaup
4 Lesser Scaup
361 Goldeneye
390 Bufflehead
275 Old Squaw
3,010 White-winged Scoter
1 American Scoter
2 Ruddy Duck
2 Cooper's Hawk
3 Red-tailed Hawk
1 Red-shouldered Hawk
3 Rough-legged Hawk
6 Marsh Hawk
16 Sparrow Hawk
27 Pheasant
1 Clapper Rail
10 Killdeer
10 Purple Sandpiper
3 Sanderling
1 Glaucous Gull
5 Iceland Gull
622 Black-backed Gull
70,785 Herring Gull
15 Ring-billed Gull
2 Laughing Gull
642 Bonaparte's Gull
1 Kumlien's Gull
70 Rock Dove
6 Mourning Dove
1 Screech Owl
1 Long-eared Owl
4 Short-eared Owl
2 Flicker
10 Hairy Woodpecker
37 Downy Woodpecker
70 Prairie Horned Lark
56 Blue Jay
1,557 Eastern Crow
10 Fish Crow
85 Black-capped Chickadee
6 Tufted Titmouse
39 White-breasted Nuthatch
1 Red-breasted Nuthatch
2 Brown Creeper
3 Robin
2 Bluebird
9,988 Starling
2 Myrtle Warbler
287 English Sparrow
18 Meadowlark
310 Redwing
4 Rusty Blackbird
1 Purple Grackle
68 Cowbird
39 Cardinal
8 Pine Siskin
21 Goldfinch
5 Savannah Sparrow
119 Junco
32 Tree Sparrow
16 Field Sparrow
60 White-throated Sparrow
2 Fox Sparrow
40 Song Sparrow
1 Lapland Longspur
2 Snow Bunting

The twenty observers were:

*Irving Black
Howard H. Cleaves
*Mr. Collins
Barbara Cook
*Mr. Deckenback
H. Ray Hunt
Mrs. H. Ray Hunt
Lee A. Ellison
*Frank Frazier
R. Bruce Gordon
Vera Gordon
*Joseph Jehl
John LeMaire
Robert Mathewson
*Nick Niosi
Casimir Redjives
Mrs. Donald Smith
Mathilde P. Weingartner
*Mr. Westcott
Floyd Wolfarth

* Observers from New Jersey—members of the Urner Ornithological Club.

BOOK REVIEWS

THE OPEN SEA — Its Natural History: The World of Plankton, by Alister C. Hardy. Houghton Mifflin Company, Boston. 1956. 335 pages. $6.50.

"To describe the plankton of our seas, and to set it in its pattern of community, climate, sea-scene and season is a major task. Professor Hardy has brought vast knowledge and experience and scholarship to a synthesis never before attempted." So say the editors of *The Open Sea* in their prefatory remarks.

These statements are true, but they do not adequately describe this splendid book. Professor Hardy writes with contagious enthusiasm. He also has a truly remarkable knack for making difficult and complicated subjects really understandable. And despite the great scope of the book he speaks with the authority of first-hand knowledge.

Twelve years in the writing, *The Open Sea* is an eminently readable and interesting account—not only of the small, drifting plankton organisms, but also of deep sea creatures, vertical migrations, luminescent marine life, and squids, cuttlefish, and their kin. It is highly recommended to anyone who considers himself in any way a student of ocean life. The superb photographs of living plankton by Douglas P. Wilson and the illustrations in color and black and white by the author are themselves worth the price of the book.

F. G. Wood, Jr.

WILLIAM PAGE, THE AMERICAN TITIAN, by Joshua C. Taylor. University of Chicago Press, Chicago. 1957. 316 pages. $8.50.

"What were his compelling ideas? What in his work and personality made him so important to his time?" It was in response to these questions that Joshua C. Taylor undertook his study of William Page. The artist's family made available to him a mass of material that had remained stored away, due to litigation after Page's death, and Mr. Taylor used it to revive the ghostly memory of a man whose works and reputation were threatened with near extinction.

Mr. Taylor acquaints his readers with Page's education, his early efforts, historical paintings which have since disappeared, and portraiture in America and Europe; his engravings made to augment his slender income; his association with the National Academy, the American Academy of Fine Arts, and the American Art Union; his admiration for the tradition of Titian (evidenced by his pilgrimage to Allston and his direct copies of Titian's work) rather than submission to the influence of the British School (principally Lawrence); his experimentation in the application of color in layers and the concept of the "middle tint"; the penetrating study of the idea and the concept of unity in his paintings; the criticism of those who felt that he was a "mannerist" or that he leaned too often in the direction of the European Masters; his strong prejudices that made him an unreliable

historian and a limited critic, but a more vigorous lecturer. Mr. Taylor writes also of Page's European travels, friendships, and acquaintances; of his three marriages; of his individualism, uncompromising manner in life, and his inquiring mind. "It should be remembered," says Mr. Taylor, "that Page's worth was judged by many as much on the basis of his ideas as on his art . . ."

Of particular interest to this journal is the fact that William Page lived for some time on Staten Island, where he died. He is buried in the Moravian Cemetery at New Dorp.

T. Gilbert Brouillette

MORE ABOUT BOOKS

THE WARBLERS OF AMERICA: A Popular Account of the Wood Warblers as They Occur in the Western Hemisphere. Edited by Ludlow Griscom and Alexander Sprunt, Jr. Illustrated by John Henry Dick. 356 pages. The Devin-Adair Company, New York. 1957. $15.00.

A beautiful as well as a practical book, *The Warblers of America* contains 33 reproductions in color of paintings by John Henry Dick and contributions to its text by an impressive list of leading ornithologists. The book is made up of individual write-ups, and is edited by Ludlow Griscom and Alexander Sprunt, Jr. Mr. Sprunt has taken care of 31 of the write-ups himself. Range maps show breeding areas, and delightful black and white drawings are used as decorations and space fillers. A check-list is included. The book is intended for the general reader interested in birds, as well as for the more advanced student wishing to have at hand a brief but comprehensive account of the entire family of wood warblers.

WHITE PATCH, A CITY SPARROW, by Olive L. Earle.* 64 pages. William Morrow and Company, New York. 1958. $2.50.

Olive L. Earle has added another character to her list of creatures who endear themselves to child and adult reader alike. As in the preceding books in this series, Miss Earle's accuracy in text and illustration provides a dependable lesson in natural history which the reader absorbs with delight, while the hazards that beset the central character's existence provide an element of suspense. The fact that White Patch takes the ferry from the Battery to St. George is a touch that brings him close to Staten Islanders, and they rejoice that he finds a home in Miss Earle's hospitable garden. Miss Earle's latest book for children is a plausible little story, charmingly told, and the beautiful crayon drawings with which she has illustrated it delight mature artists as well her young readers. It is a little volume that most grown-ups will part with reluctantly when they send it on its way to the special small person for whom it has been purchased.

* Staten Island resident.

COUNTERFEITING IN COLONIAL CONNECTICUT, by Kenneth Scott.* 292 pages. The American Numismatic Society, New York. 1957. $5.00.

Choosing Colonial Connecticut as the locale for his latest published investigations, Kenneth Scott has contributed further historical data on the subject of counterfeiting. The book, he says, is intended primarily for numismatists but he hopes it will also be useful for economists, historians, and genealogists. It covers the period from 1699 to 1776, with the chapters arranged by periods of years to make the book easily used for reference purposes. Painstaking research, discriminating selection of material, and careful presentation characterize Mr. Scott's history of the nefarious practices of a surprisingly large group of people. The book is well documented and indexed, with 46 plates added to acquaint the reader with the appearance of the counterfeited bills.

ON THE TRAIL OF VANISHING BIRDS, by Robert Porter Allen. 251 pages. McGraw-Hill Book Company, Inc., New York. 1957. $4.50.

When such spectacular birds as the whooping crane, the flamingo, and the roseate spoonbill are threatened with extinction, the desire to help to save them leads a bird lover into adventures of great extent geographically and moments of keen excitement. Robert Porter Allen, Research Director of the National Audubon Society, accepted such a challenge and experienced some success and much heartbreak—which did not surprise him, since he is said to be the leading authority on threatened species. This book is his personal story of a search that led him from Florida Bay to the tundra of the Arctic Coast and from the West Indies to northern breeding grounds.

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* Staten Island resident.

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James L. Whitehead, ***Director and Editor of Publications***

Volume XXI

Number 1

Fall 1958

CONTENTS

Dr. Hecht, the author of the paper here presented, has contributed to the science program of the Staten Island Institute of Arts and Sciences. He is Assistant Professor of Biology at Queens College, New York, and Research Associate of the American Museum of Natural History, Department of Paleontology. He holds the degrees of B.S., M.S. and Ph.D. from Cornell University. This paper is a summation of his doctoral dissertation. It is of particular interest to students of the natural history of the northeastern United States.

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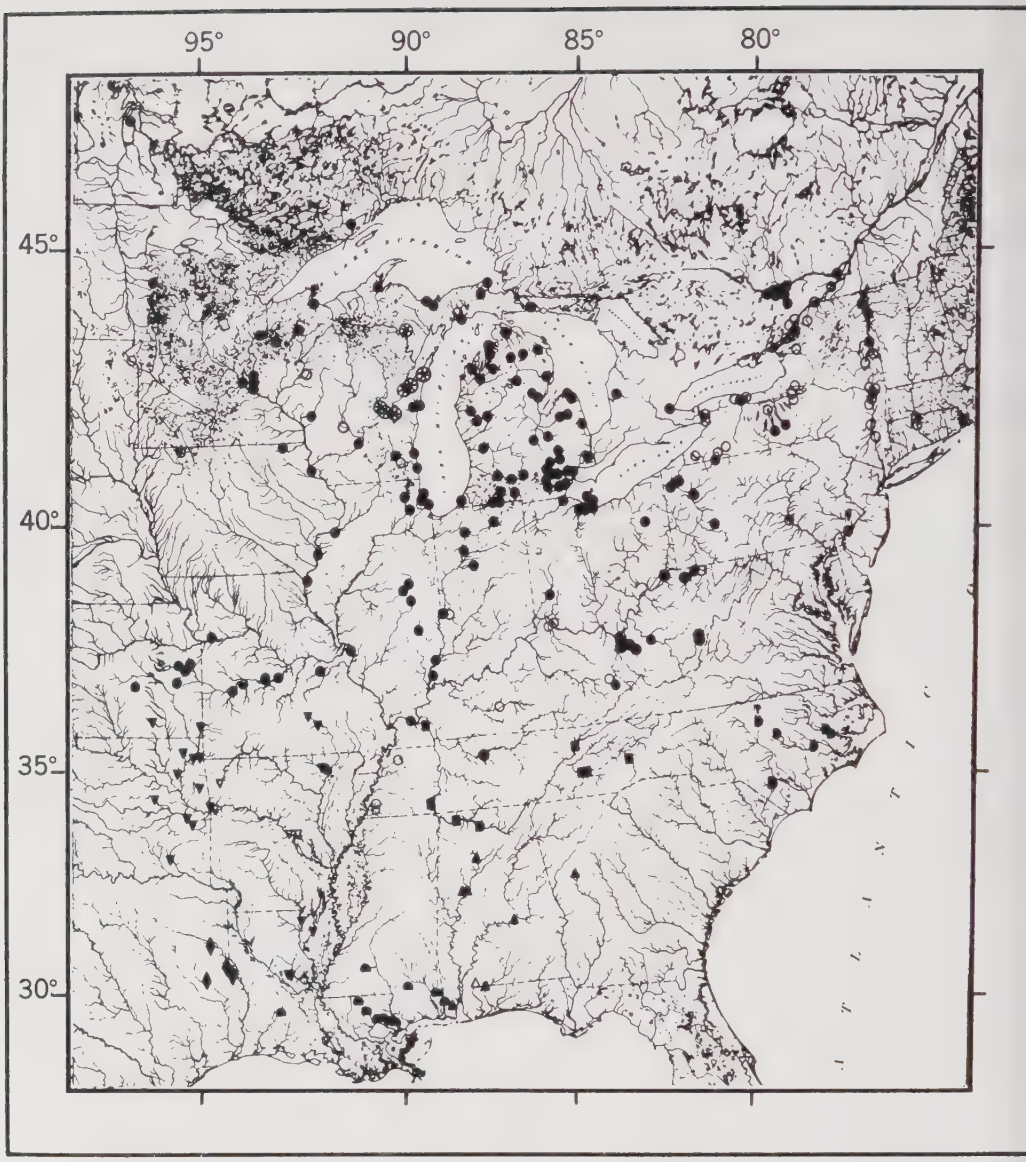


MAP 1. Eastern United States showing the locality records for *Necturus maculosus*, *Necturus beyeri*, and *Necturus lewisi*. Solid symbols represent material examined; hollow symbols represent literature records.

Circles—*Necturus maculosus maculosus*

Encircled star—*Necturus maculosus stictus*

Inverted triangle—*Necturus maculosus louisianensis*

Rectangle—*Necturus maculosus* populations from the Tennessee River

Semicircle (with flat side vertical)—*Necturus lewisi*

Semicircle (with flat side down)—*Necturus beyeri*

Triangle—*Necturus beyeri alabamensis*

Diamond—Texan populations of *Necturus beyeri beyeri*

A SYNOPSIS OF THE MUD PUPPIES OF EASTERN NORTH AMERICA

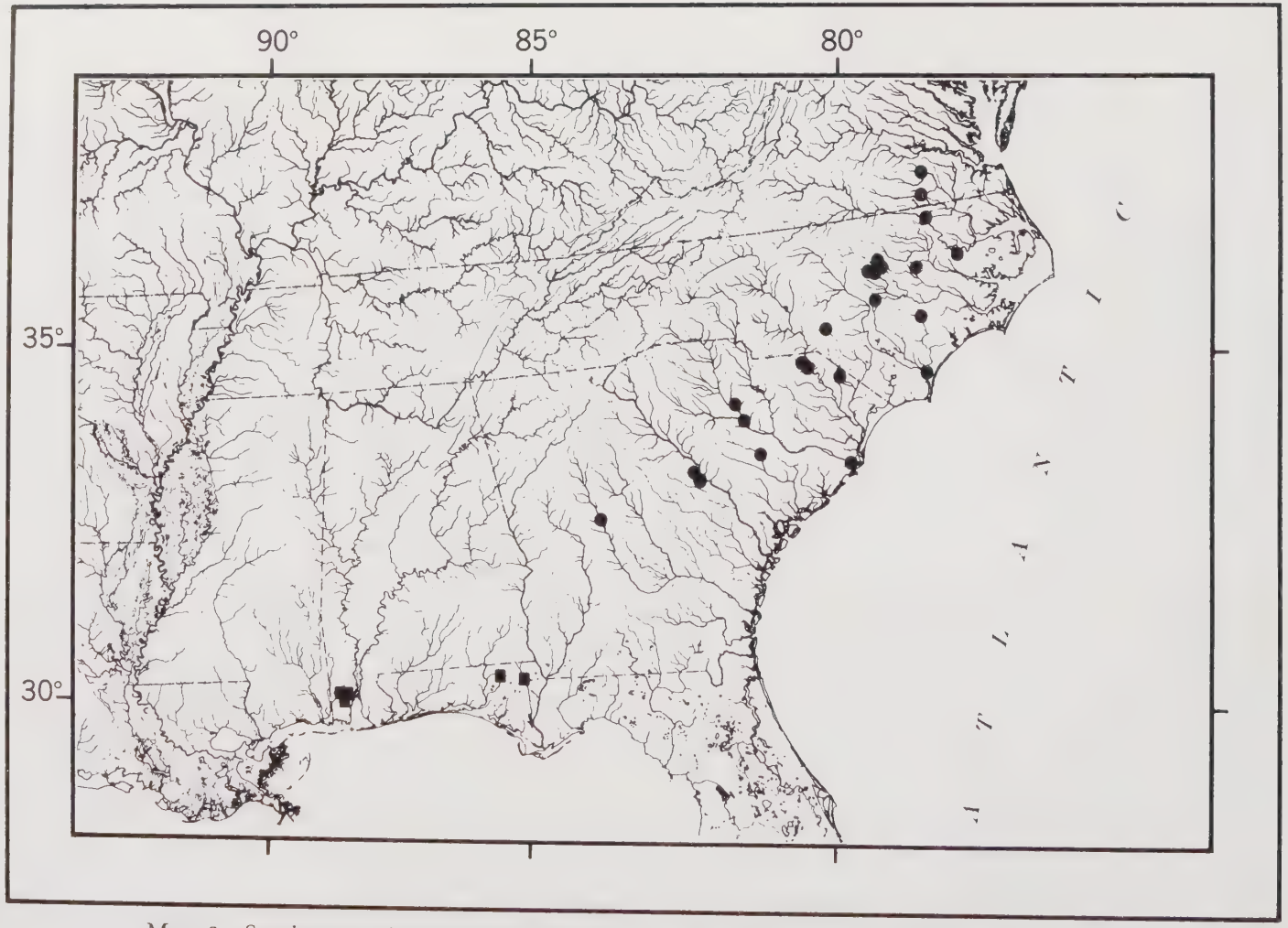
By
MAX K. HECHT

THE SALAMANDERS of the genus Necturus are known throughout eastern United States as water dogs or mud puppies. They are a group familiar to many fishermen and of particular interest to biologists because of the vast amount of experimental work done with them. Despite this, there has been general nomenclatorial turmoil and uncertainty as to the number and kinds of forms within the genus. In 1947 a review of *Necturus* was undertaken to determine the relationships of the different forms and to identify some specimens which were collected outside the known range of the genus. As a result a monograph was submitted as a doctoral thesis to Cornell University, based on the study of nearly 2500 specimens. As a part of this study the relationships of the genus *Necturus* to other salamanders was investigated and discussed elsewhere (Hecht, 1957). It is not the intention of the present report to present the entire study because of the limitation of space, but to present here the systematic results, key to the forms, and complete survey of the distribution. The actual data upon which the study is based will be found in the aforementioned thesis. The purpose of this review is to make available to various workers the systematic conclusions of my study.

STUDY MATERIAL

The material on which this study was based is derived from the collections of the following universities and museums. To these institutions and individuals the author wishes to express his sincere thanks for their kindness in making material in their care or personal collections available for study:[1] A. E. Allin of Fort Williams, Ontario (A.E.A.); Mr. Paul Anderson of Independence, Missouri (P.A.); Dr. Albert P. Blair, University of Tulsa (U.T.);

[1]Abbreviations to be used subsequently in the paper when referring to specimens, indicating collection and number, are given here in parentheses.



MAP 2. Southeastern United States showing the locality records for *Necturus punctatus*.
Solid circles—*Necturus punctatus*

the late Dr. Sherman C. Bishop, University of Rochester (S.C.B.); Mr. Charles M. Bogert, American Museum of Natural History (A.M.N.H.); Dr. Arthur N. Bragg, University of Oklahoma Museum of Zoology (U.O.M.Z.); Dr. W. J. Breckenridge, Minnesota Museum of Natural History (M.M.N.H.); Dr. Kenneth Carlander, Iowa State College (I.S.C.); Dr. Fred R. Cagle, Tulane University (T.U.); Mr. E. B. Chamberlain, Charleston Museum (Ch.M.); Dr. Doris Cochran, United States National Museum (U.S.N.M.); Mr. Ralph Dury, Cincinnati Society of Natural History (C.S.N.H.); Dr. E. R. Dunn, Academy of Natural Sciences of Philadelphia (A.N.S.P.); Dr. Bryan P. Glass, Oklahoma Agricultural and Mechanical College Museum of Zoology (O.A.M.C.M.Z.); Dr. Howard K. Gloyd, Chicago Academy of Sciences (C.A.S.); Mr. N. B. Green, Marshall College (M.C.); Dr. Arnold B. Grobman, University of Florida (U.F.); Mr. Robert F. Inger and Mr. Clifford Pope, Chicago Museum of Natural History (C.M.N.H.); Mr. Frank Meacham, North Carolina State Museum (N.C.S.M.); Mr. K. W. MacArthur, Milwaukee Public Museum (M.P.M.); Mr. Wilfred T. Neill, Silver Springs, Florida (W.T.N.); Dr. Grace Orton and Dr. M. Graham Netting, Carnegie Museum (C.M.); Mr. Clyde Patch, National Museum of Canada (N.M.C.); Dr. Edward C. Raney, Cornell University (C.U.); Mr. Ottys Sanders, Dallas, Texas (O.S.); Mr. Benjamin Shreve and Mr. Arthur Loveridge, Museum of Comparative Zoology (M.C.Z.); Dr. Hobart M. Smith, University of Illinois (U.I.); Mr. Philip W. Smith, Illinois Natural History Survey (I.N.H.S.); Mr. Arthur N. Stupka, Great Smoky Mountain National Park (G.S.M.N.P.); Mr. Ralph Sinclair, Shelby State Forest, Tenn. (now in A.M.N.H. collection); Dr. E. H. Taylor, Kansas University Museum of Natural History (U.K.M.N.H.); Dr. Charles F. Walker, University of Michigan Museum of Zoology (U.M.M.Z.); Mr. J. J. Keleher of the Fisheries Research Board of Canada (F.R.B.C.); Dr. Joseph Bailey of Duke University (J.B.); Mr. Barry Valentine (B.V.).

NOMENCLATORIAL HISTORY

The first scientific description of *Necturus* was given by Schneider (1799: 50) from a specimen collected in Lake Champlain. He placed it in the "lizard genus" *Salamandra,* but he gave it no specific name. Lacepede (1807) named and figured this unique salamander in a lengthy description noting that each limb had four toes and placed it as a relative of *Proteus.* In addition he

stated that it might be a paedogenetic or a normal larva because it had both gills and lungs. Lacepede gave it the vernacular name *protee tetradactyle* or *salamandre tetradactyle.* Rafinesque (1818: 40) described this same form as *Sirena maculosa* in the nomenclatorial form that conforms with the International Code of Zoological Nomenclature. Rafinesque in 1819 proposed the generic name *Necturus* for this salamander. In addition to referring to the previously described *maculosus* as *maculatus,* Rafinesque (1819) listed in the same paper, eight other forms referring the reader to a former paper, "Memoires sur les reptiles des Etats-Unis dans l'*American Scientific Journal.*" A careful search for this paper does not reveal its publication in the *American Scientific Journal,* nor is it listed in a bibliography in R. E. Call's (1895), "The Life and Writings of Rafinesque." Apparently this reference is another one of Rafinesque allusions to "published" papers. Rafinesque's biographer states (p. 136) that Rafinesque considered as published any paper submitted to a journal. Apparently many such titles never appeared in print. Mitchill (1821: 183; 1824: 24) believed the American animal to be congeneric with *Proteus* although he recognized it as a separate species. Rafinesque (1820: 4) listed *Necturus maculatus* and briefly described two other species: *Necturus luteus* and *Necturus phosphoreus.* These two forms may actually represent the juvenile stages of *Necturus maculosus.* Leuckart (1821: 260) erected the genus *Phanerobranchus* for Lacepede's "*P. tetradactylus.*" Say (1823: 5) described a young specimen from the Allegheny River at Pittsburgh as *Triton lateralis.* Harlan (1824: 233) proposed the genus *Menobranchus* for Say's species *lateralis.* Barnes (1826: 287) referred to this species as *Proteus lateralis.* Fitzinger (1826: 66) listed the same form as *Phanerobranchus cepedii.* Wegler (1830: 210) used the combination *Necturus lateralis* listing the following synonyms: *Proteus tetradactylus* Lacepede; *Triton lateralis* Say; *Menobranchus lateralis* Harlan. Holbrook (1842: 115) listed two species, *Menobranchus maculatus* (Barnes) and *Menobranchus lateralis* (Say), although he suggested that the two forms may be the same species. Gray (1850: 66) was the first since Rafinesque (1820: 4) to use the correct combination, *Necturus maculosus.* Also Gibbes (1850: 159) described the first valid species since *S. maculosa* Rafinesque (1818) naming it *Menobranchus punctatus.* Kneeland (1857: 152) described *Siredon hyemalis* and in the following year placed it in the genus *Menobranchus.* Boulenger (1882: 84) apparently over-

looked Rafinesque's (1818 and 1820) publications in referring to *Necturus maculatus* in 1882. Garnier (1888: 218) described a new variety of *Menobranchus, M. lateralis* var. *latastei* from the Lucknow River in Ontario, Canada. The combination, *Necturus maculatus* was used by Cope (1889: 23); he recognized only one other species in the genus, *Necturus punctatus* (Gibbes). Waite (1907: 27) summarized the nomenclatorial history of *Necturus maculosus*, pointing out some of the previous errors in citing this species. Brimley (1924: 1) described a new subspecies, *Necturus maculosus lewisi* from the Neuse River, North Carolina. A tentative revision of the genus *Necturus* was published in 1937 by Viosca, who also described three new species from the southern Gulf drainages. These were *Necturus alabamensis, N. beyeri* and *N. lodingi.* In this same paper he considered *Necturus maculosus lewisi* a full species. A year later, in 1938, Viosca described another new species, *Necturus louisianensis* from the Red River drainage. King (1939: 546) designated the *Necturus* from the Little Tennessee River, as *Necturus maculosus* X *alabamensis* Viosca. Brimley (1939: 2) considered *N. lewisi* a species. Bishop (1941: 35) referred to the mudpuppy in New York as *Necturus m. maculosus* considering *lewisi* a subspecies of *maculosus.* Bishop (1941b: 9) described a new subspecies, *Necturus maculosus stictus* from Lake Winnebago, Wisconsin. In the "Handbook of Salamanders," Bishop (1943) considered *Necturus alabamensis* Viosca a synonym of *Necturus beyeri* Viosca, and allocated King's Little Tennessee River *Necturus* to the species, *Necturus beyeri.* In this same work, the last authoritative treatment of the genus, the following forms were recognized: *Necturus maculosus maculosus* Rafinesque, *Necturus maculosus stictus* Bishop, *Necturus lewisi* Brimley, *Necturus louisianensis* Viosca, *Necturus beyeri* Viosca, *Necturus lodingi* Viosca, and *Necturus punctatus* (Gibbes). Chermock (1952) listed the species in the state of Alabama as *Necturus punctatus lodingi, Necturus maculosus maculosus* and *Necturus maculosus beyeri.* Schmidt (1953) in the "Checklist of North American Amphibians and Reptiles" recognized *Necturus maculosus maculosus* Rafinesque, *Necturus maculosus stictus* Bishop, *Necturus maculosus beyeri* Viosca, *Necturus maculosus louisianensis* Viosca, *Necturus maculosus lewisi* Brimley, *Necturus punctatus* Gibbes and *Necturus lodingi* Viosca. Blair, Blair, Brodkorb, Cagle and Moore (1956) recognize only two species, *Necturus maculosus* with five subspecies and *Necturus punctatus* with two subspecies.

CHARACTER ANALYSIS

Thirteen variable characteristics were studied. All of these were utilized in some manner or other in the diagnosis of the various forms. Many of these characters were of limited use because of the diverse methods of preservation adding an error which placed limitations on the results.

1. SEX: Determination of sex was made by gross examination of the gonads and correlation with secondary sexual characters at the time of collection. Reproductive state was also noted.

2. SNOUT-VENT LENGTH: Taken ventrally and measured from the anterior border of the snout to the posterior border of the vent.

3. HEAD LENGTH: Taken ventrally and measured from the anterior border of the snout to the first gill opening.

4. INTERLIMB LENGTH: The distance between the axilla and the groin.

5. TAIL LENGTH: The distance from the posterior border of the cloaca to the tip of the tail.

6. DORSAL PATTERN: Ground pattern, presence or absence of spots, approximate size and number of spots, distribution of melanophores.

7. VENTRAL PATTERN: Ground color, presence or absence of spots, distribution of melanophores, size of spots.

8. COSTAL GROOVES: The number between the anterior and posterior limbs including the first one behind the anterior limb and the last one anterior to the midpoint of the hind limbs.

9. COSTAL GROOVES BETWEEN ADPRESSED TOES: The number of costal grooves not covered by adpressed limbs when all the digits are outstretched.

10. PREMAXILLARY TEETH: Number of teeth borne by premaxillary bone. Inasmuch as bilateral asymmetry was common, the right and left sides were added and utilized as a single figure. Empty sockets were included in the count.

11. VOMERINE TEETH: Number of teeth borne by the vomerine bone. Counts made in the same manner as in the premaxillary teeth.

12. PTERYGOID TEETH: Number of teeth borne by the pterygoid bone. Counts made in the same manner as in the premaxillary teeth.

13. VERTEBRAL COUNTS: X-rays were made of small samples of adults of all the forms in the genus. Position of the girdles along the vertebral column were noted. These data were correlated with the number of costal grooves between the axilla and groin.

All the data obtained were arranged so as to reveal any possible ontogenetic and geographic variation as well as sexual dimorphism. A complete statistical study was done on all characters so as to reveal any correlation between any two or more characteristics studied. As a result of these studies it was shown that all the forms of *Necturus* have essentially the same growth patterns for all of the above listed linear characters. Therefore body proportions reveal little in attempting to distinguish between the members of the genus. The X-ray study of the vertebral column revealed that the costal groove count was a good indicator of the position of the pelvic girdle and the number of vertebrae which were between the two girdles. The number of costal grooves showed limited geographic variability and were not too useful in identification. The number of costal grooves between adpressed toes and most of the other linear measurements had limited utility because of the various methods of preservation, which added a new margin of error.

An analysis of the number of teeth revealed an unexpected difficulty. If teeth number of similar size groups of the different forms of mudpuppies were compared, little difference between the forms could be detected. Yet it was clear that in those individuals or species which attained a snout-vent length of over 150 mm. there was a definite trend to increase the total number of teeth. As a result, on first inspection it would appear that there are more teeth in the larger species than in the smaller species. This, of course, is not true if the comparison is made of individuals in the same size category.

A comparative study of the color patterns revealed further ontogenetic changes. In the young animals the color and patterns are restricted to the dorsum, but gradually they invade the lateral and ventral surfaces. The invasion of the ventral surfaces by the

dorsal color patterns begins at about a snout-vent length of 130 mm. Despite these ontogenetic changes the color pattern is useful in diagnosis of the various forms. The larvae of the northern species is characterized by the presence of striped larvae, but even this pattern disappears in individuals with a snout-vent length of 70 mm.

Two of the most diagnostic characteristics in the genus *Necturus* are the maximum size and minimum breeding size. These two features made it possible to recognize the different species groups. It was soon evident that minimum breeding size is directly correlated with the maximum size of the species.

The quantitative data were treated in the following uniform manner: statistics were computed from the nine quantitative characters listed above: observed range, mean, standard deviation, standard error of the mean and coefficient of variation. Frequency of characters was arranged by size groups using snout-vent length, to note any increase or decrease in occurrence. To verify the extent and statistical significance of geographic variation and sexual dimorphism, the Chi Square test was applied on discrete variates and Student's test on continuous variates. To represent graphically growth phenomena in various body proportions, scatter diagrams were made plotting the raw data. Coefficients of regression were calculated from the raw observational data. These were: tail length and snout-vent length; interlimb length and the snout-vent length minus the interlimb length; head length and the snout-vent length minus the interlimb length; head length and the snout-vent length minus the head length. From the coefficients of regression, regression lines were plotted for the different species. The limited number of adequately preserved *Necturus lewisi* prevented a complete analysis of this species. Only those specimens in which the sex was determinable were used. The data for each sex were plotted separately to eliminate any distortion due to sexual dimorphism. Tests were made to determine the significance of the differences between two regression coefficients. As a result of these studies it was found that the general growth pattern was constant throughout the genus and that the species did not differ significantly. This is not to say that there are no differences between the species in growth pattern of these structures, but that the error introduced by different preserving techniques does not allow us to utilize differences which are less than the amount of change produced by different preserving techniques.

Field investigations were conducted during the summers of 1947, 1948, and 1951. As a result of this work, new material was obtained from Texas, Georgia, and Florida. Further studies were conducted around Crabtree Creek and Little River in North Carolina where two sympatric forms are known to occur. In addition to the above studies, life history data were gathered from necturi in the yacht basin at the southern end of Cayuga Lake near Ithaca. The purpose of this study was to collect an ontogenetic series from a single locality.

The analysis of all these data is expressed in the following systematic arrangement and key to the forms:

SPECIES

The *Necturus punctatus* group

This group may be defined as a small unspotted species (or rarely with spots or blotches) with unspotted unicolored larvae. The smallest breeding individuals were found to be between 65 and 75 mm. in snout-vent length, with a maximum length of 135 mm. This species is composed of two allopatric subspecies: *Necturus punctatus punctatus* (Gibbes) and *Necturus punctatus lodingi* Viosca.

Necturus punctatus punctatus Gibbes

DIAGNOSIS: Differs from its nearest relative, *Necturus punctatus lodingi,* by its smaller size, greater number of costal grooves between the adpressed toes (range 5-9, mean 7.3); fewer vomerine teeth (range 15-22, mean 17.6); generally darker color on dorsum (Fig. 1 F).

DISTRIBUTION: From the Chowan River system south to the Altamaha River, in the states of Virginia, North Carolina, South Carolina, and Georgia.

REMARKS: This form is the only type which definitely occurs sympatrically with another species of *Necturus, N. lewisi.* In the Neuse and Tar Rivers the ecological separation between these two forms is clear cut. *Necturus punctatus* occupies the smaller, slower, and warmer streams.

MATERIAL EXAMINED:

Chowan River drainage: C.U. 5468 (Sussex Co., Virginia); C.U. 5470 (Greensville Co., Virginia).

Roanoke River drainage: C.U. 5467 (Northhampton Co., North Carolina); C.U. 5468 (Martin Co., North Carolina).

Tar River drainage: A.M.N.H. 53891 (Edgecomb Co., North Carolina).

Neuse River drainage: N.C.S.M. 121, 191, 192, 201, 202, 205, 207, 210, 211, 214, 275, 438, 508, 592, 593, 596, 609-13, 620, 623, 621, 624, 795-800, 7302; A.M.N.H. 415221, 415574, 50157-50161 (Wake Co., North Carolina).

Cape Fear River drainage: N.C.S.M. 98, 99, 101 (Harnett Co., North Carolina); C.U. 5465 (Duplin Co., North Carolina); U.S.N.M. 12594 (New Hanover Co., North Carolina).

Pee Dee River drainage: C.U. 5464 (Darlington-Chesterfield Cos., South Carolina); C.U. 5465 (Moore Co., North Carolina); C.U. 5469 (Chesterfield Co., North Carolina); U.M.M.Z. 67783 (Dillon Co., South Carolina).

Santee River drainage: U.S.N.M. 11813, Ch.M. (Charleston Co., South Carolina); Ch.M. 33.254.1 (Richland Co., South Carolina).

Edisto River drainage: Ch.M. (Orangeburg Co., South Carolina).

Savannah River drainage: W.T.N. 17781, W.T.N. 1165 (Richmond Co., Georgia).

Altamaha River drainage: U.M.M.Z. 67783 (Bibbs Co., Georgia).

ADDITIONAL RECORDS IN LITERATURE:

North Carolina: Harnett, Wake, Sampson Cos. (Brimley, 1939).

Necturus punctatus lodingi Viosca

DIAGNOSIS: Differs from its nearest relative, *Necturus punctatus punctatus,* by attaining a larger size in at least the males, by having a greater number of vomerine teeth (range 16-24, mean 20.4), a lower mean number of costal grooves between the adpressed toes (range 5-7, mean 6.0), and by having a uniformly lighter dorsal color, and in general lacking spots (Fig. 1 E).

DISTRIBUTION: From the Dog River drainage, Mobile County, Alabama eastward to the Apalachicola River system in Florida and probably Georgia.

REMARKS: Most of the available adult specimens of this form are known from one area in the Dog River drainage. All the other localities are represented by primarily advanced larvae.

MATERIAL EXAMINED:

Apalachicola River drainage: A.M.N.H. 53899, U.M.M.Z. 90054 (Jackson Co., Florida).

Choctawhatchee River drainage: 53892-95 (Holmes-Washington Cos., Florida).

Dog River drainage: U.S.N.M. 61752, M.C.Z. 23020-23, C.U. 3465, T.U. 1974, 1940, 1980, 1978, 1931, 1932, 1598, 1973, 1975, 1941, 1971, 1951, 1855, 1979, 1939, 1937, 1977, 1945, 1938, 1947, 1933, 1946, 1952, 2243, 2246 (Mobile Co., Alabama).

The *Necturus lewisi* group

This group may be defined as a species group differing from its congeners by its non-striped larvae, and spotted, medium-sized adults. It is composed of two allopatric species, *Necturus lewisi* Brimley and *Necturus beyeri* Viosca.

Necturus lewisi Brimley

DIAGNOSIS: Distinguished from its closest relative, *Necturus beyeri,* by attaining a larger maximum snout-vent length of at least 175 mm., a smaller breeding size (between 100 and 105 mm.), and by having a darker ventrum and dorsum produced by progressive invasions of melanophores in the larger individuals (Fig. 1 A).

DISTRIBUTION: Tar and Neuse River systems of North Carolina.

REMARKS: This species is certainly the more elusive of the North Carolina water dogs. From the available data it appears that this is a salamander of the larger rivers and deeper waters. This would explain the greater abundance in collections of *Necturus punctatus.* All of the available adult material of *N. lewisi* was collected by fish hooks in the late winter and early spring months (February to April). I have studied the area around Raleigh where the two species are known to occur together in one or two streams. Unfortunately it has not been possible to collect the larger form. One specimen of *Necturus lewisi* from the Eno River presents an interesting problem. It was given to C. Brimley by a fisherman and deposited in the North Carolina State Museum. An examination of the habitat indicates to me that the data are incorrect, since the habitat is vastly different from the other known localities. This locality is also the only known locality so far above the Fall Line.

A single larva from the Pee Dee River drainage (from a tributary of the Lumber River, Moore Co., North Carolina) may represent the first record of this species outside the Neuse and Tar River drainages. This specimen is about 80 mm. in snout-vent length and therefore identification cannot be certain. Positive identification must await the collection of adult specimens. It is possible that the more southern drainages may contain intermediate types between *Necturus lewisi* and *Necturus beyeri.*

MATERIAL EXAMINED:

Tar River drainage: U.S.N.M. 7015 (Edgecomb Co., North Carolina); N.C.S.M. (Beaufort Co., North Carolina).

Neuse River drainage: N.C.S.M. (Orange Co.); N.C.S.M., N.C.S.M. 34312, 271, 266, 267, 268, Br.A., 270, 269, 265, M.C.Z. 5877, 17727, 17726, J.B., U.S.N.M. 73848, U.F. 1120 (Wake Co.); U.S.N.M. 8348 (Lenoir Co., North Carolina).

Pee Dee River drainage: J.B. (Moore Co., North Carolina).

The species *Necturus beyeri*

This species can be defined as a spotted, medium sized species of *Necturus* (attaining a maximum snout-vent length of 160 mm. and a minimal breeding size of 118 mm.) with unstriped larvae and the lack of melanophore invasion of the dorsal and ventral ground color.

Necturus beyeri beyeri Viosca

DIAGNOSIS: Differs from all its relatives within the species *Necturus beyeri* by having a greater number of costal grooves between the adpressed toes (range 6-9, mean 7.5); by having a greater number of premaxillary teeth (range 15-24, mean 18.9); by having a spotted abdomen in the larger mature specimens, and a more spotted dorsum (Fig. 1 B).

DISTRIBUTION: From the Angelina River bottoms, Texas, along the Gulf coastal drainage of Louisiana to the Escatawpa River, Mississippi.

REMARKS: The analysis of the available material indicates that the Texan populations from the Sabine River drainage may be slightly differentiated. Some workers may prefer to attach a new name to this form. Our present material is inadequate in number to determine whether this population merits a trinomial. Local inhabitants have claimed observations from a more westerly drainage; however, no specimens have been seen by the author.

MATERIAL EXAMINED:

Sabine River drainage: C.U. 4911; O.S. (Gregg Co., Texas); M.C.Z. 30421 (Shelby Co., Texas).

Neches River drainage: M.C.Z. 30418-20; M.C.Z. (to be deposited); C.U. 4913 (Nacogdoches Co., Texas).

Calcasieu River drainage: U.S.N.M. 10674-76, N.C.S.M., M.C.Z. 17732-33, T.U. 1669, 1687, 1674, 1671, 1690, 1685, 1678, 1676, 1675, 1686, 1688, 1673, 1677, U.M.M.Z. 81910 (Allen Parish, Louisiana).

Tickfaw River drainage: T.U. 1645, 1646, 1647, 2312 (St. Helene Parish, Louisiana).

Tangipahoa River drainage: T.U. 1786 (Tangipahoa Parish, Louisiana).

Bogue Falaya River drainage: S.C.B., T.U. 1793, 1794, 1390, 1768 (St. Tammany Parish, Louisiana).

Bayou Lacombe River drainage: T.U. 2237, 2247, 2263, 2308, 2309, 2310, 2311, 1624, 1642, 1627, 1623, 1622, 1634, 1626, 1635, 1625, 1753, 1758, 1759, 1762, 1764, 1769, 1771, 1774, 1787, 1805, 1641, 1640, 1636, 1639, 1647, 1638, 1889, 1890, 1916, 1894, 1892, 1655, 1666, 1652, 1654, 1663, 1662, 1653, 1657, 1661, 1667, 1658, 1651, 1665, 1660, 1656, 1659, 1541, 1621, 1536, 1562, 1597, 1391, 1620, 1609, 1542, 1888, 1790, 2290, 2291, 2292, 2293, 2294, 2295-2306, 1528, 1618, 1397, 1410, 1603, 1406, 1524, 1402, 1613, 1394, 1390, S.C.B. (St. Tammany Parish, Louisiana); U.M.M.Z. 81911.

Pearl River drainage: T.U. 2178, 2148, 2204, 2165, 2157, 2134, 2177, 2190, 2191, 2188, 2130, 2128, 2131, 2164, 2193, 2144, 2141, 2094, 2129, 2211, 2184, 2127, 2172, 2124, 2111, 2150, 2123, 2133, 2151, 2182, 2118, 2146, 2156, 2126, 2112, 2037, 2122, 2045, 2061, 2113, 2040, 2093, 2159, 2121, 2088, 2081, 2116, 2056, 2090, 2082, 2074, 2120, 2048, 2115, 2155, 2089, 2091, 2086, 2043, 2055, 2065, 2069, 2076, 2062, 2073, 2072, 2077, 2057, 2117, 2070, 2059, 2078, 2052, 2023, 2046, 2175, 1770, 1921, 1928, 1925, 1908, 1853, 1896, 1858, 1924, 1930, 1912, 1917, 1922, 1923, 1911, C.U. 3467, 4355 (St. Tammany Parish, Louisiana).

Pascagoula River drainage: U.M.M.Z. 90056 (Lamar Co., Mississippi).

Escatawpa River drainage: U.M.M.Z. 98700 (George Co., Mississippi); T.U. 1628-1633 (Mobile Co., Alabama).

ADDITIONAL RECORDS IN LITERATURE:

Neches River drainage: Rusk Co., Texas (Brown, 1950).

Necturus beyeri alabamensis Viosca

DIAGNOSIS: Differs from all its relatives within the species, *N. beyeri,* in having an immaculately white ventrum throughout life, a reduced number of spots on the dorsum (Fig. 1 D), an intermediate number of costal grooves between the adpressed toes (range 5-8, mean 6.5) and more premaxillary teeth (range 17-26, mean 20.1).

DISTRIBUTION: From the Alabama River drainage and the smaller Gulf coastal streams eastward to the Apalachicola River drainage.

REMARKS: This subspecies is one of the most distinct forms in the genus. Almost all the known specimens can be easily separated from *Necturus b. beyeri* except on a few characters or a few rare individuals. The immature stages of the two forms are extremely similar.

MATERIAL EXAMINED:

Alabama River drainage: T.U. 1751, 1755, 1808, 1760, 1772, 1798, 1792, 1800, 1784, 1789, 1763, 1756, 1795, 1699, 2008, 1996, 1992, 1987, 1984, 1954, 2010, 1964, 1983, 1983, 1957, 2002, 1967, 1960, 1976, 1961, 1986, 1955, 1966, 2009, 1982, 2000, 1963, 1968, 1962, 1997, 1773, 1787, 1780, 1810, 1806 (Walker Co., Alabama); U.S.N.M. 102676 (type), C.U. 4723, T.U. 1696, 1689 (Tuscaloosa Co., Alabama); B.V. (Marion Co., Alabama).

Perdido River drainage: U.M.M.Z. 90055 (Escambia Co., Alabama).

Apalachicola River drainage: A.M.N.H. 53896-53899 (Coweta-Fayette Cos., Georgia).

ADDITIONAL LOCALITY RECORDS IN LITERATURE:

Alabama River drainage: Montgomery Co., Alabama (Loding 1922).

The *Necturus maculosus* group

This species may be defined as differing from its congeners by its striped larvae, spotted dorsum, large size (attaining a maximum size of 300 mm. snout-vent length) and an increase in teeth in the larger size classes. This species is composed of three subspecies, *Necturus maculosus maculosus* Rafinesque, *Necturus maculosus louisianensis* Viosca, and *Necturus maculosus stictus* Bishop.

Necturus maculosus maculosus (Rafinesque)

DIAGNOSIS: Differs from its closest relatives, the other subspecies of *Necturus maculosus,* by the spread of the dorsal pattern, with its darkened ground color, to the ventral surface (Fig. 1 H), as contrasted to the generally clear ventrum of *louisianensis;* by the progressive ontogenetic darkening of the dorsal surface but lacking the fine punctations of *stictus.*

DISTRIBUTION: Occurs in the Missouri River system east of the Great Plains; in the Mississippi River system north of the Missouri River junction; the Ohio River system; the Great Lakes and tributaries; Ottawa River and upper St. Lawrence River; Lake Champlain; upper Hudson and Connecticut Rivers, the Red River of the North and the Tennessee River system.

REMARKS: This northern subspecies differs from all the other forms of mud puppies by having a polymorphic population in the Great Lakes. In the Great Lakes a small percentage of the larvae are of a non-striped form and thus indistinguishable from the southern species. This polymorphic unicolored larva reaches its greatest frequency in Lake Erie where in some localities it is the most abundant form.

There is a slight cline within this species as to the degree of melanophore invasion of the dorsal color pattern. The southern populations tend to have less darkening of the dorsal color. The population of the Tennessee River is most characteristic in this respect, especially in the headwaters. This same population also is often characterized by a clear ventrum in the larger specimens.

The record from the brackish water of the lower Delaware River near Philadelphia is either erroneous or that of a released specimen. The Connecticut River population may represent an introduced population.

MATERIAL EXAMINED:

Mississippi River System—

Ohio River drainage: S.C.B. 13-16, 4170, A.M.N.H. 56128-30 (Cattaraugus Co., New York); S.C.B. 3130, A.M.N.H. 21452-21456, M.C.Z. 16259-16263, C.M. 4019 (Crawford Co., Pennsylvania); A.N.S.P. 21391, 10988-10994 (Indiana Co., Pennsylvania); U.M.M.Z. 86780 (Warren Co., Pennsylvania); C.U. 4939 (McKean Co., Pennsylvania); C.M. 5896, 6132, 6133, 6134, 6261, 25802 (Venango Co., Pennsylvania); C.M. 2840, 7469 (Allegheny Co., Pennsylvania); C.U. 3115 (Kanawha Co., West Virginia); U.M.M.Z. 86570, O.A.M.C.M.Z. 372 (Floyd Co., Kentucky); C.N.H.S. 1590 (Hamilton Co., Ohio); U.M.M.Z. 98763

(Shelby Co., Ohio) ; U.M.M.Z. 84276, U.M.M.Z. (SL) 847-849 (Stark Co., Ohio) ; M.C.Z. 940 (Fossey Co., Indiana) ; U.S.N.M. 39673 (Vigo Co., Indiana) ; U.S.N.M. 42918 (Carroll Co., Indiana) ; U.S.N.M. 33441-33445, 33553-7, 42596-42597 (Marshall Co., Indiana) ; U.M.M.Z. 98763 (White Co., Indiana) ; U.S.N.M. 12079 (Wabash Co., Illinois) ; I.N.H.S. 1880 (Cumberland Co., Illinois) ; I.N.H.S. 1003 (Massac Co., Illinois) ; A.N.S.P. 464, 467 (Wabash River).

Missouri River drainage: K.U. 805, U.M.M.Z. 68383 (Franklin Co., Kansas) ; K.U. 806 (Jefferson Co., Kansas) ; K.U. 812, 23321 (Miami Co., Kansas) ; K.U. 19575 (Anderson Co., Kansas) ; P.A. 990-991, 2673-2674, 4601 (St. Clair Co., Missouri) ; P.A. 2675 (Benton Co., Missouri) ; P.A. 2676, 4916 (Morgan Co., Missouri) ; P.A. 2677 (Miller Co., Kansas) ; C.A.S. 15034 (Jackson Co., Missouri).

Upper Mississippi River drainage: U.S.N.M. 31063 (St. Louis Co., Missouri) ; U.M.M.Z. 93116 (Winneshick Co., Iowa) ; I.S.C. 36 (Jackson Co., Iowa) ; I.S.C. 304 (Lee Co., Iowa) ; M.C.Z. 133 (Scott Co., Iowa) ; I.N.H.S. 1001, 2995 (Champaign Co., Illinois) ; I.N.H.S. 2994 (Piatt Co., Illinois) ; I.N.H.S. 3029 (Douglas Co., Illinois) ; C.M.N.H. 14799 (McHenry Co., Illinois) ; I.N.H.S. 1002 (Rock Island Co., Illinois) ; I.N.H.S. 1402-1403 (Dodge Co., Wisconsin) ; U.M.M.Z. 64820 (Jackson Co., Wisconsin) ; U.M.M.Z. 69624 (Washburn Co., Wisconsin) ; C.N.H.M. 6293-6296 (Sawyer Co., Wisconsin) ; M.M.N.H. 1077 (Dakota Co., Minnesota) ; M.M.N.H. 1084, 1087-1089, 1647-1651, 1076 (Washington Co., Minnesota).

Red River of the North drainage: M.M.N.H. 933 (Norman Co., Minnesota) ; U.S.N.M. 7007, F.R.B.C. 3 specimens (Lake Winnipeg, Manitoba).

Tennessee River drainage: U.M.M.A. 97630 (Buncombe Co., North Carolina) ; G.S.M.N.P. NMXA, N3, U.M.M.Z. 90057 (Polk Co., Tennessee) ; U.M.M.Z. 82957 (Anderson Co., Tennessee) ; U.M.M.Z. 86489 (Blount Co., Tennessee) ; U.M.M.Z. 100022 (Morgan Co., Alabama) ; T.U. 1643-1644, U.M.M.Z. 96013 (Lauderdale Co., Alabama) ; U.M.M.Z. 92353 (Livingston Co., Kentucky).

The Great Lakes System—

Lake Superior drainage: C.M.N.H. 18431, U.I.M.N.H. 1401 (Ashland Co., Wisconsin) ; U.M.M.Z. 83272 (Chippewa Co., Michigan) ; U.M.M.Z. 48539-48541, 83878 (Alger Co., Michigan) ; U.M.M.Z. 61772-61773, 61705 (Luce Co., Michigan) ; U.M.M.Z. 63134 (Houghton Co., Michigan).

Lake Huron-Michigan drainage: U.S.N.M. 7060 (Racine Co., Wisconsin) ; C.M.N.H. 38695 (Du Page Co., Illinois) ; C.N.H.M. 2801, 45000, C.A.S. 218-220, 10871 (Cook Co., Illinois) ; U.M.M.Z. 82104, 83877 (Mackinac Cos., Michigan) ; U.M.M.Z. 47362, 82087 (Schoolcraft Co., Michigan) ; U.M.M.Z. 63111 (Alpena Co., Michigan) ; U.M.M.Z. 90528 (Antrim Co., Michigan) ; U.M.M.Z. 90502, 90503 (Arenac Co., Michigan) ; U.M.M.Z. 51204 (Berrien Co., Michigan) ; U.M.M.Z. 64947

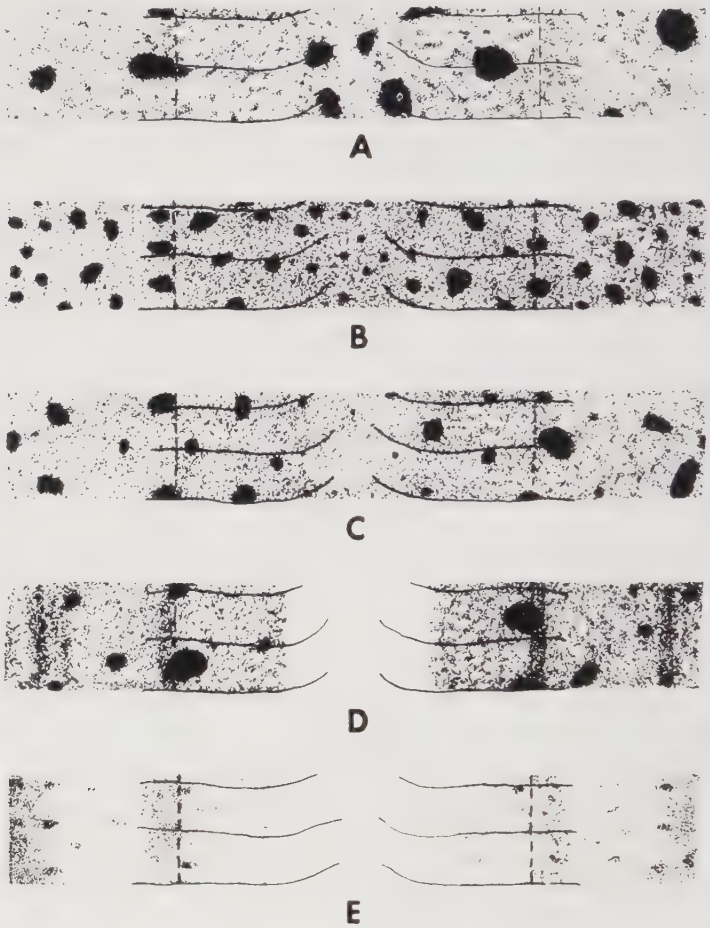


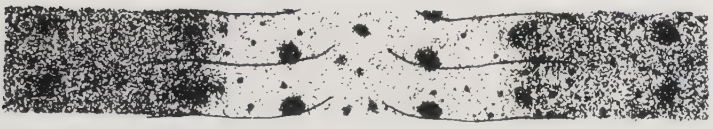
FIG. 1. Mid-body patterns of adults of all forms of *Necturus* showing
entire section of skin between three costal grooves in mid-body. Mi
ventrum in center of each drawing; broken line indicates mid-lateral li
(diagrammatic).

A. *Necturus lewisi*—ground color dark brown

B. *Necturus beyeri beyeri*—ground color reddish brown

C. *Necturus beyeri beyeri* (western population)—ground color brown or reddi
brown

F



G

H

I

J

D. *Necturus beyeri alabamensis*—ground color reddish brown

E. *Necturus punctatus lodingi*—ground color brown

F. *Necturus punctatus punctatus*—ground color dark brown or black

G. *Necturus maculosus stictus*—ground color dark brown or black

H. *Necturus maculosus maculosus*—ground color dark brown or black

I. *Necturus maculosus louisianensis*—ground color reddish to dark brown

J. *Necturus maculosus maculosus* (Tennessee River population)—ground color reddish to dark brown

(Branch Co., Michigan) ; U.M.M.Z. 89970 (Calhoun Co., Michigan) ; U.M.M.Z. 58551 (Charlevoix Co., Michigan) ; U.M.M.Z 39798, 40474, 52335, 56754, 61811 (Cheboygan Co., Michigan) ; U.M.M.Z. 61799 (Emmett Co., Michigan) ; U.M.M.Z. 64292 (Genesee Co., Michigan) ; U.M.M.Z. 82093 (Hillsdale Co., Michigan) ; U.M.M.Z. 42076, 42889, 82086 (Huron Co., Michigan) ; U.M.M.Z. 61703, C.M.N.H. 2762 (Iosco Co., Michigan) ; U.M.M.Z. 83819 (Jackson Co., Michigan) ; U.M.M.Z. 59157 (Kalamazoo Co., Michigan) ; U.M.M.Z. 65072 (Kalkaska Co., Michigan) ; U.M.M.Z. 85105 (Kent Co., Michigan) ; U.M.M.Z. 83962 (Lake Co., Michigan) ; U.M.M.Z. 30503, 70176 (Livingston Co., Michigan) ; U.M.M.Z. 63135 (Mecosta Co., Michigan) ; U.M.M.Z. 62599, 64378, 74497 (Montmorency Co., Michigan) ; U.M.M.Z. 63463 (Newaygo Co., Michigan) ; U.M.M.Z. 62600, 74308 (Otsego Co., Michigan) ; U.M.M.Z. 63925, 63994 (Oakland Co., Michigan) ; U.M.M.Z. 59156 (Roscommon Co., Michigan) ; U.M.M.Z. 83011 (Sanilac Co., Michigan) ; U.M.M.Z. 74543 (Shiawassee Co., Michigan) ; U.M.M.Z. 83271, A.N.S.P. 25667 (St. Clair Co., Michigan) ; U.M.M.Z. 82102, 82103 (Tuscola Co., Michigan) ; U.M.M.Z. 83272 (Chippewa Co., Michigan) ; U.S.N.M. 67040-67041 (Bruce Co., Ontario) ; U.M.M.Z. 38891, 38892 (St. Joseph Co., Michigan).

Lake Erie drainage: U.M.M.Z. 6429, 64948-64949, 65439, 70381 (Lenawee Co., Michigan) ; U.M.M.Z. 44637, 55609, 56323, 56669, U.S.N.M. 32103-32105 (Monroe Co., Michigan) ; U.M.M.Z. 34246, 34398, 41723, 45632, 84728, 84729, C.M. 18724, A.N.S.P. 455-456, 16128 (Washtenaw Co., Michigan) ; U.M.M.Z. 413, 57090 (Wayne Co., Michigan) ; U.M.M.Z. 66718 (Lake Erie off Kelly's Island) ; U.M.M.Z. 77527-77532 (Lucas Co., Ohio) ; U.S.N.M. 19801 (Put-in-Bay, Lake Erie) ; U.M.M.Z. 100023 (South Bass Island, Lake Erie) ; U.S.N.M. 25899-25900, U.M.M.Z. 52115 (Sandusky Co., Ohio).

Lake Ontario and St. Lawrence River drainage: N.M.C. 1385 (Wentworth Co., Ontario) ; S.C.B. 1177-1178, 1196-1198, 17 (Monroe Co., New York) ; C.U. 5017 (Schuyler Co., New York) ; C.U. 2862, 1559, 3965, A.N.S.P. 15615, A.M.N.H. (not catalogued), M.C.Z. (Tompkins Co., New York) ; U.M.M.Z. 97332 (Onondaga Co., New York) ; M.C.Z. 1772 (St. Lawrence Co., New York) ; N.M.C. 180, 188, 1036, 1199, 1542, 1581, 1623, 1739, 1739, 1750, 1751, 1754, 1785, 1799 (Carleton Co., Ontario) ; N.M.C. 1589, 1906 (Ottawa Co., Quebec) ; N.M.C. 2097 (Jacques Cartier Co., Quebec) ; M.C.Z. 127 (Essex Co., New York) ; M.C.Z. 276 (Lake Champlain, New York) ; A.N.S.P. 10435 (Delaware Co., Pennsylvania).

ADDITIONAL RECORDS IN LITERATURE:

Breathitt, Campbell, and Kenton Cos., Kentucky (Drury and Williams, 1933) ; Wabash, Franklin, Marshall, Monroe (Hay, 1887, 1892), Marion (Mittleman, 1947), Lake, Porter (Edgren and Stille, 1948) Cos., Indiana; Peoria Co., Illinois (Garman, 1892) ; Butler, Stoddard and Jasper Cos., Missouri (Hurter, 1911) ; Waukesha Co., Wisconsin (Cahn and Shumway, 1926) ; Dickerson Co., Iowa (Blanchard, 1920) ; Grant and Roberts

Cos., South Dakota (Over, 1923); Frontenac, Glengany, Stormont and Leeds Cos., Ontario (Toner and St. Remy, 1941); Albany, Allegheny, Chautauqua, Clinton, Dutchess, Erie, Orleans, Oswego, Rensselaer, Saratoga, Seneca, Ulster and Wayne Cos., New York (Bishop, 1941); Dauphin Co., Pennsylvania (Surface, 1906); Hartford Co., Connecticut (Babbitt, 1937); Hardin and Benton Cos., Tennessee (Sinclair, 1950).

Necturus maculosus louisianensis Viosca

DIAGNOSIS: A subspecies of *Necturus maculosus* differing from the other subspecies by its reduced color or pattern development on the ventral surface and reduced melanophore invasion of the dorsal ground color (Fig. 1 I).

DISTRIBUTION: The Red River, Arkansas River and intervening smaller drainages on the west side of the Mississippi River.

REMARKS: This is one of the more poorly defined subspecies in the genus. In the lowlands the adults are as diagnosed above, but in the headwaters and in the northern part of the range the populations resemble the southern populations of the northern species. This form may actually represent the southern end of a north-south cline. More specimens are needed for a final decision as to its status.

No specimens of *Necturus* are known from the eastern side of the Mississippi River opposite the known localities for this subspecies. Material from this area would be of primary interest.

MATERIAL EXAMINED:

Red River drainage: U.S.N.M. 104238, T.U. 1508, 1553, 1561, 1590, 1602, 1692, 1698, 1862, 1865, 1868, 1864, 1865, 1868, 1869, 1859, 1870, 1871, 1874, 1873, 1876, 1882, 1898, 1891, 1903, 1910, 1918, 1604, 1617, C.U. 4724, S.C.B., C.M. 19036 (Grant Co., Louisiana); T.U. 2278 (Oachita Parish, Louisiana); U.O.M.Z. 25228-25229 (Richland Parish, Louisiana); U.T. (Pushmataha Co., Oklahoma).

Arkansas River drainage: M.C.Z. 17730-17731 (Lawrence Co., Arkansas); U.M.M.Z. 90446, 91956 (Shannon Co., Missouri); U.S.N.M. 4058 (Crawford Co., Arkansas); U.T. (Delaware Co., Oklahoma); U.T., U.O.M.Z. 18923 (Mayes Co., Oklahoma); O.A.M.C.M.Z. 72, 24 (Craig Co., Oklahoma); O.A.M.C.M.Z. 71 (Latimer Co., Oklahoma); K.U. 21430, 16913 (Greenwood Co., Kansas); K.U. 20629 (Chase Co., Kansas); K.U. 23291 (Crawford Co., Kansas).

ADDITIONAL RECORDS IN LITERATURE:

Arkansas River drainage: Crawford Co., Pulaski Co., Washington Co., Arkansas (Black, 1938).

Necturus maculosus stictus Bishop

DIAGNOSIS: The largest subspecies of *Necturus maculosus*, differing from its nearest relatives, by the presence of a uniform dark gray dorsum with

fine black or brown punctations over the entire dorsum; differing from the southern populations of this species by the darkening of the dorsal ground color and fine punctations in the dorsal pattern of the larger size classes (Fig. 1 G).

DISTRIBUTION: Green Bay and its tributaries in Wisconsin and Michigan.

REMARKS: This is one of the larger forms within the genus. It is not clearly defined and many of the larger individuals in other populations strongly resemble the larger characteristic individuals of this subspecies. The smaller adults of this population are indistinguishable from similar individuals of other populations.

MATERIAL EXAMINED:

Green Bay drainage: U.M.M.Z. 89765 (type), 89766, 90736, C.M. 22074, S.C.B. 18-21, A.N.S.P. 24256 (Winnebago Co., Wisconsin); U.M.M.Z. 40321 (Dickinson Co., Michigan).

KEY

A. Adults attain reproductive maturity at 140-150 mm. snout-vent length; larvae usually striped, though rarely unstriped.

B. Ventrum never or rarely spotted in the adult; dorsum reddish with few melanophores in ground color.

C. Adults not exceeding 180 mm. snout-vent length; dorsum reddish tan but with few black dorsal blotches (Fig. 1J); populations from the Tennessee river drainage. . . . . *Necturus maculosus maculosus* Rafinesque

CC. Adults exceed 180 mm. snout-vent length; dorsum reddish but with many black dorsal blotches; dorsum becoming gray in largest specimens (exceeding 200 mm.) but not obscuring black dorsal blotches; known from the Arkansas and Red river drainages. . . . . *Necturus maculosus louisianensis* Viosca

BB. Ventrum invaded by the dorsal ground color and by dorsal blotches; in adults of over 160 mm. dorsal color always grayish in alcohol.

C. In largest adults (exceeding 180 mm.) all specimens with gray dorsal ground color (in preservative) submerging the black blotches and covered with small prominent black punctations; restricted to the Green Bay (of Wisconsin) drainage. . . . . *Necturus maculosus stictus* Bishop

CC. Most large specimens not as above; generally with prominent dorsal blotches and rarely covered with fine punctations; no specimen with these punctations has the entire dorsal pattern covered with same; distributed through the upper Mississippi river system, Red River of the North, the Great Lakes system, the upper Hudson and Connecticut Rivers. Reported from the Susequehanna River. . . . . *Necturus maculosus maculosus* Rafinesque

AA. Adults attain reproductive maturity before 125 mm. snout-vent length; adults never exceeding 180 mm. snout-vent length; larvae never striped.

B. Adult dorsum with large dorsal black blotches; reproductive maturity attained by 110-115 mm. snout-vent length.

C. Dorsum with many dorsal black blotches; ventrum of adults invaded with spots and dorsal ground color.

D. Attaining a maximum size of at least 175 mm.; general darkening of the dorsal and ventral pattern in the largest individuals; known from the Neuse and Tar river drainages of North Carolina. . . . . *Necturus lewisi* Brimley

DD. Attaining a maximum size of 160 mm.; no general darkening of the dorsum and ventrum.

E. A lesser number of costal grooves between the adpressed toes (average 5); a lesser number of premaxillary teeth (average 16.8); populations from the Sabine and Neches river drainages of Texas. . . . . *Necturus beyeri beyeri* Viosca

EE. A greater number of costal grooves between toes (mean 8); a greater number of premaxillary teeth (mean 18.9); restricted to the Gulf coastal drainages of Mississippi and Louisiana. . . . . *Necturus beyeri beyeri* Viosca

CC. Adult dorsum with few dorsal black blotches; ventrum of the adult always immaculate, never invaded by spots or by ground color; restricted to the Alabama, Apalachicola and other eastern smaller Gulf coastal drainages between these two larger rivers. . . . . *Necturus beyeri alabamensis* Viosca

BB. Dorsum with no blotches but sometimes with few small punctations; venter always immaculate, never invaded by dorsal ground color; adults attaining reproductive maturity by 65-70 mm. snout-vent length; adults never exceeding 130 mm. snout-vent length.

C. Dorsum generally darker; a greater number of costal grooves between the toes (mean 7); a lesser number of prevomerine teeth (mean 17.6); restricted to the Atlantic coastal drainages from the Chowan River in Virginia south to the Altamaha River of Georgia. . . . . *Necturus punctatus punctatus* (Gibbes)

CC. Dorsum is generally lighter; a lesser number of costal grooves between the toes (mean 6.0); a greater number of prevomerine teeth (mean 20.4); restricted to eastern Gulf coastal drainages from the Dog River in Alabama eastward to the Chipola River in Florida. . *Necturus punctatus lodingi* Viosca

SUMMARY AND CONCLUSIONS

A. CRITERIA FOR TAXONOMIC CATEGORIES

Before the systematist can make his decisions as to the biological or systematic status of the forms under study he must have established for himself some criteria as to the limits of the various hierarchical categories. In a study of a genus, the investigator must define for himself the usefulness or significance of naming the categories. There is a general assumption among many biologists that we are all using the same definition of the basic categories. If we assume that the basic category in Linnean nomenclature is the species and that this same category is also the basic category to the evolutionary biologist, then we have arrived at a starting point. The definition of a species used in this paper is that of Mayr (1942 p. 120): "Species are groups of actually or potentially interbreeding natural populations, which are reproductively isolated from other such groups." However, the problem faced by the systematist is to obtain (usually) on the basis of morphological data alone, a biological interpretation of the facts. This is complicated in the case of closely related forms (as in the case of the species of *Necturus*) by the lack of distinct morphological differences. I have used, as my basic criterion, the existence of reproductive isolation, as indicated by the degree of resemblance between forms at the point of contact, or closest approximation of ranges, or areas of actual geographic sympatry. The populations from these areas should indicate the degree of difference between these forms and would also help interpret the variation of the intermediate populations, if they exist. It is only in these areas that genic interchange could now occur. I also assume that morphological species differences are usually the result of a great number of genetic factors. I would then expect that if genetic interchange takes place, it would be reflected by the intermediacy of the population morphology. If in these areas of closest contact or actual geographic sympatry, I find two arrays of forms with no intermediacy in distinguishing characters, I assume that there are two reproductively isolated units. The relationship of *Necturus lewisi* and *Necturus punctatus* in the Neuse and Tar River drainages of North Carolina is of this type. Probably a similar relationship exists between *Necturus punctatus* and *Necturus beyeri* in the Gulf coastal drainages of Alabama and the panhandle of Florida.

It must be admitted that *Necturus* is an aquatic form with many of its populations isolated in parallel river systems with little opportunity for genic interchange. Here I have assumed that the amount of variation in each population will offer a key to the degree of specific differentiation. If there is an overlap of morphological characteristics, then I have regarded the forms as being conspecific even though they may be distinguishable. The relationship of *Necturus maculosus louisianensis* and the undescribed Tennessee River form to the northern subspecies is a good example of this criterion. Furthermore, if, in allopatric populations, there is a distinct dichotomy of morphological characters, then I have regarded the forms as being specifically distinct and most probably reproductively isolated. The relationship of *Necturus maculosus* and *Necturus beyeri* is a good example of this criterion. As a result I have come to the conclusion that there are four distinct species of *Necturus.* They are: *Necturus punctatus, Necturus beyeri, Necturus lewisi* and *Necturus maculosus.*

Within the above species of salamanders there are distinguishable populations which can be characterized and identified. These are usually designated and named as subspecies. Normal herpetological and ichthyological procedures would require the description of new subspecies for any population which is distinguishable at least at the seventy-five percent level. It appears to me that, by using combinations of characters, most population students could then describe innumerable subspecies and split the species into an infinite number of identifiable races. Whether such a procedure has biological significance or not is open to question. I do not feel that the subspecies is a useless category. It is particularly useful in the identification or recognition of species with a ring-type distribution. In these forms the terminal end forms are geographically sympatric and therefore have approached the species level of differentiation. For this level of differentiation the trinomial is useful. Agreement on this point is unlikely among systematists. Wilson and Brown (1953) have adequately pointed out the chaotic situation produced by excessive subspecies splitting. I do agree that the use of concordant characters would reduce the number of subspecies to be described, but I doubt whether concordance in character dispersal is any more meaningful biologically than mosaic type of character distribution. If one uses the criterion of character concordance in the genus *Necturus,* then probably only one valid subspecies would stand, *Necturus beyeri alabamensis.* Perhaps those who would prefer lower criteria for subspecies recognition would

consider this form to be at the specific level of differentiation. It is for the above reason—lack of concordant variation—that I have not described the Tennessee River population and the Texan populations as new subspecies.

B. SYSTEMATIC CONCLUSIONS

From the above diagnoses and key, it is evident that the genus *Necturus* is made up of four similar species, which resemble each other in body proportions, growth form and pattern development. Primary differences between species are found in the age of the development of sexual maturity (as indicated by snout-vent length) and maximum length. Within each species are some local populations which are identifiable. The taxonomic status of these populations depends on a value judgment rather than biological criteria. If populations with minor non-concordant features should be recognized then we must establish two new subspecies for the Tennessee River and Sabine River populations. If one follows a lumping classification, then *Necturus maculosus stictus* and *Necturus maculosus louisianensis* should be synonymized with *Necturus maculosus maculosus.* The status of the subspecies, *Necturus punctatus lodingi* depends on the identity of adult material from the more eastern drainages. *Necturus beyeri alabamensis* represents one of the more distinct races in the genus. In recognition of my indecision on this nomenclatorial level, I have retained all forms in the keys and maps.

On the specific level only *Necturus punctatus* and *Necturus lewisi* pass the systematic test of geographic sympatry. There is some evidence that in the Gulf coast of Louisiana, Mississippi, Alabama, and the panhandle of Florida that *Necturus beyeri* and *Necturus punctatus* occur in the same river systems and may actually be sympatric. Only further collecting can offer the final proof in this respect because of the difficulty in identifying larvae and subadults.

Necturus maculosus is completely allopatric (so far as known) to all species. It is closest morphologically to the *N. lewisi* group, but the degree of morphological differences is as great as between *Necturus lewisi* and *Necturus punctatus* and greater than between *Necturus beyeri* and *Necturus punctatus.* Therefore the specific status of *Necturus maculosus* is based on comparative morphology rather than on actual isolating mechanisms. Further collecting in the lower Mississippi valley may prove or disprove the present

arrangement, but the evidence at present indicates the specific level of differentiation. The specific status of *Necturus lewisi* is a case similar to that of *Necturus maculosus* except here the morphological relationship to *Necturus beyeri* is closer, with a much larger gap in the known distribution. *Necturus lewisi* is accorded specific status because it differs from the main pattern of water dog differentiation by having an unexpected small minimum breeding size and unexpected large maximum size. In all other forms minimum breeding size and maximum size are closely correlated. It would have been expected that a species with a smaller minimum breeding size than *Necturus beyeri* would not have attained such a large maximum size.

Lastly, it is admitted that the proposed key will be difficult to use and, in fact, most single specimens will not be identifiable without locality data. This is an inconvenience which is apparently the result of the general pattern of evolution within this group. The mud puppies have evolved primarily by sliding the correlated minimal breeding size and maximum size up and down along a single growth axis.

ACKNOWLEDGMENTS

This summary is the result of a study of the genus *Necturus* presented as a doctoral thesis at Cornell University. I wish to express my thanks to the various authorities at the innumerable institutions which made material available for this study. I would also like to express my thanks to Bessie Hecht, who aided in many aspects of the work; to Dr. Sam McDowell for his diagrammatic figure of the color patterns, and to Drs. Samuel Horowitz, Carl Gans, and Karl Koopman for aid, criticism and encouragement.

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Publication of the *Proceedings* will be suspended with this issue. Items of general interest hereafter will appear in *The New Bulletin*, published monthly, except July and August. Purely scientific articles will be published in *Occasional Papers*, which will be mailed to our members upon request.

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FRESH WATER FISH OF STATEN ISLAND

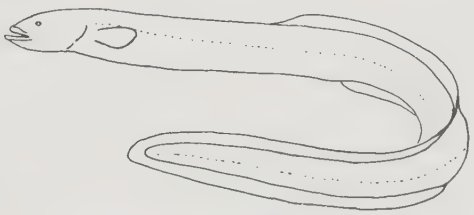
By

ROBERT F. MATHEWSON

THE PAUCITY of species of fresh water fish on Staten Island results from two fundamental factors: (1) the isolation from the mainland waterways, and (2) the gradual drop of the local water table with the resulting diminishing supply of fresh water. These conditions bring about considerable changes in water temperature and a higher degree of pollution, seriously affecting the breeding and life habits of the fish. Records[1] indicate that there was a greater abundance of species and individuals here in the past.

Fourteen different kinds of fresh water fish are found. Five hundred animals were examined in the course of this study. While this is not a large sampling, the data are supported by the observations and findings of other people.

The distinctive characters of the fish and the small number of species representing the total population in question, permit us to omit lengthy character descriptions.[2] The accompanying line drawings furnish key characters necessary for species identification.



AMERICAN EEL

Anguilla bostoniensis (Le Sueur)

The snake-like appearance of the American eel quickly identifies this animal. Full grown adults reach a length of three to four feet.

Eels go through an interesting life cycle, which was first described by J. Schmidt in 1925 in *The Breeding Place of the Eel*, and was added to in great detail by Leon Bertin in his book, *Eels*, published in 1956.

After four to seven years of life in the fresh water lakes of Staten Island—Clove Lakes, Wolf's Pond, Arbutus Pond, Flagg's Pond, and

[1] W. T. Davis, *Proceedings of the Natural Science Association of Staten Island*, Vol. VI, No. 14, pp. 51-2; 1898.

[2] Complete morphological descriptions are found in the books listed in the Bibliography on p. 51.

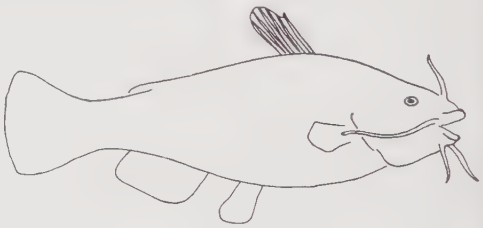
others—the adult eels lose their greenish brown dorsal and greenish gray ventral coloration and become silvery gray. Before the complete color change has taken place, they have found their way back to the sea and have commenced the long journey to the breeding grounds, in an area just north of the West Indies.

The fate of the adults after spawning is believed to be death. The transparent larvae, which float, are carried by the current of the Gulf Stream back toward the American coastline. Eventually these larvae acquire adult characters and then, under their own power, swim toward the coast. At an age of one to two years and at a size of two to three inches they reach the fresh water streams and rivers. It is at this time that they can be seen in numbers as they work their way up the small streams toward the deeper waters of the lakes and ponds.

Eels feed upon all sorts of food either dead or alive. They will occasionally leave the water to find frogs, insects, salamanders, carrion, and similar food, in the muddy or wet banks of the lake or stream. The many slime glands located in the skin of the eel serve as a protection when the animal is molested, making it almost impossible to handle. Specimens weighing four to five pounds have been reported locally.

CATFISH, YELLOW CAT, MUD CAT, BULL HEAD

Ameiurus nebulosus (Le Sueur)

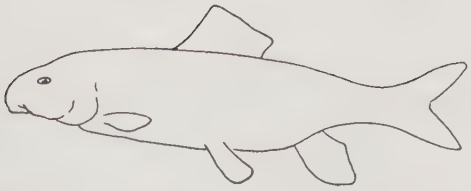


No experience in a young boy's life is accompanied by more awe, excitement, and adventure than catching his first bull head. This somewhat repulsive creature with its dark, smooth, scaleless skin and barbeled head, brought up from the muddy depths of the local pond, is indeed an exciting apparition. If it were not for the sage remark, "It can be eaten" (usually offered by an equally excited friend), plus the thrill of the catch, our ponds might soon be overstocked.

The catfish populates most of our local ponds. His omnivorous habits and adaptability to warm, cool, overgrown, open, muddy, or clear water, is merely a clue to the hardiness of this species. Even after being caught, removed from the water, and subjected to major surgery during the removal of the well-swallowed hook, this animal still clings to life enough to be able to escape if accidentally dropped back into the water.

There can be no confusion about the identity of the catfish. No other local fish possesses the head barbels—a set of sensitive organs which serve as feelers and help the fish to locate its food. Catfish do not compare with perch as a food, but, in their own right, they make a palatable meal when properly prepared.

COMMON SUCKER, WHITE SUCKER



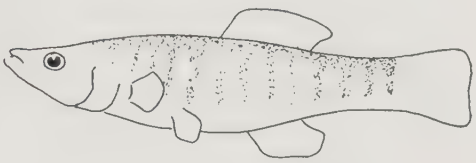
Catosomus commersonnii (Lacepede)

This is the only fish of the sucker group occurring in our fresh water streams. The poor condition (high pollution) of our water renders the flesh unsuitable for consumption. When found in areas of quick-moving, clean water, these animals provide a very palatable meal.

The mouth is situated at the anterior ventral part of the head and is particularly well suited for feeding upon the vegetation and small animal life to be found in mud and along the stream bottom. The lips are strong and papillose, and the upper lip is folded into two rows. This fish possesses no teeth except those on the bones of the throat (pharyngeal teeth). Coloration is variable. Young specimens have dark blotches along the lateral surface, but these blotches disappear in the adult specimens, which are uniformly pale green above and silvery white below.

These animals are particularly sluggish except when disturbed; then they dash for cover under the banks of the stream or scramble madly for the deeper muddy pools, where they evidently hide in the mud.

KILLIFISH



FRESH WATER
Fundulus diaphanus

SALT WATER
Fundulus heteroclitus
Fundulus majalis

On Staten Island there are three common killifish to be found, of which two are considered marine. However, both of these species can also be found in the brackish and fresh water brooks that feed into the bay and marshes.

Fundulus diaphanus is considered the fresh water species because it is found in the larger fresh water ponds. However, it can be found on occasion in brackish water. Like most killifish, it is a hardy animal and can exist in highly polluted water. This fish is omnivorous and seems to persist as readily on vegetable matter as on animal food.

The common killifish, *Fundulus heteroclitus,* populates most of our brackish waters and is quite abundant along the shore of Raritan Bay and the Kill van Kull, particularly near sewerage outlets. It is readily conditioned to fresh water and can be found far up the reaches of some of our small streams. It is used extensively as a bait fish.

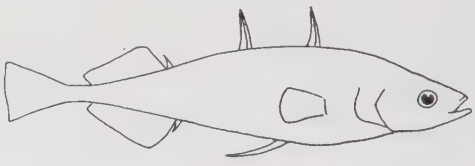
The most attractive of our local killifish is the striped species, *Fundulus majalis.* The male of this species has vertical cross bars on the

body, while on the female the stripes run horizontally. During the breeding season the colors of the male are quite distinct and attractive.

Killifish have an extensive range. *Fundulus majalis* and *Fundulus heteroclitus* occur from the Gulf of St. Lawrence to the Gulf of Mexico. *Fundulus diaphanus* ranges from Maine to Cape Hatteras.

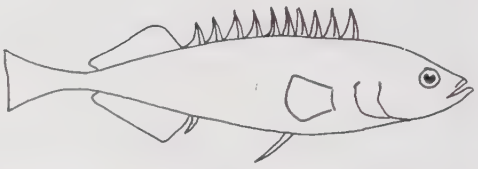
STICKLEBACK, TWO SPINED, THREE SPINED, OR NEW YORK STICKLEBACK

Gasterosteus aculeatus (Linn.)



NINE SPINED STICKLEBACK

Pungitius pungitius (Linn.)

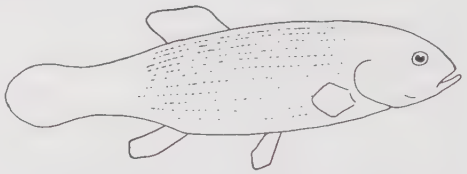


These very small fishes (maximum length four inches), which live in the fresh and brackish water streams, are among our most interesting fish. The life history of both local species is quite similar. The male, in early spring, builds a small nest of twigs and stems from aquatic plants. These he glues together with a substance exuded from the urinary tract, in much the same way as a spider spins her web. The nest is a small oval structure with a horizontal opening. When it is completed, the female is guided in and she then lays her eggs. After the eggs are deposited, the male immediately enters the nest to fertilize them and also to chase this particular female from the nest. Other gravid females may then be guided into the nest to deposit their eggs. After completion of the egg laying, the male assumes a defensive position in the nest, carefully standing guard over the eggs, protecting them particularly from other marauding sticklebacks. The eggs hatch in about ten days. However, the male will continue to protect the young even after they leave the nest. The pugnacity and voraciousness of these animals, armed as they are with sharp dorsal spines, make them a formidable enemy to creatures in their size range. Their egg eating habits make them responsible for considerable damage to the spawn of all other fish.

Their interesting behavior patterns, coupled with an ability to adjust quickly to a change in environment, make the stickleback a particularly suitable and interesting aquarium species.

MUD MINNOW, MUDFISH

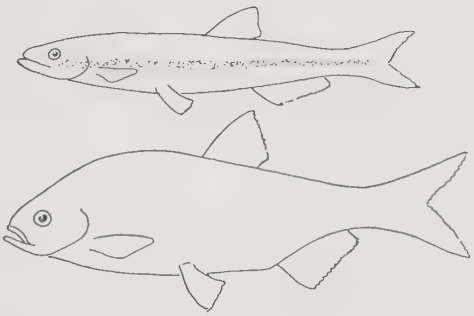
Umbra pygmaea (Kirtland)



This small fish, three to four inches long, is not common on Staten Island. Wolf's Pond, Flagg's Pond, and the small "kettle pond" at Great

Kills are the only known habitats. This fish's habit of submerging into the mud with great facility when disturbed makes it our least seen fish. Burying themselves in two or three inches of mud has probably resulted in a conditioning that enables these fish to live in the most adverse habitats. They are found in waters so choked by weed that no other fish can survive there. Unlike the sucker, *Catosomus commersonnii* (Lacepede), who also prefers muddy situations, the mud minnow is an active fish. It can occasionally be seen leaping entirely clear of the water in pursuit of an insect that is flying six to eight inches above the surface. In the aquarium, in which they are hardy and interesting, mud minnows will actively pursue their food, which consists of aquatic insects, larvae, worms, and crustaceans, as well as vegetable matter.

Spawning takes place in the early spring. At this time these animals swim up into the small brooks that feed the ponds, and lay their eggs among the pebbles and on the sandy bottom of the brook. The eggs have a glutinous coating which acts as an adhesive, holding them in place in the moving water. Whether or not the parent stands guard over the clutch is not known; however, adult fish have been found lying half hidden near the nest.



SHINER, ROACH, DACE

Brama crysoleucas

This rather large minnow, which is fairly common in some of our more hidden ponds and waterways, reaches seven inches in length. Its extreme variation in color pattern and shape, as a juvenile and as an adult, causes considerable confusion. (See illustrations: the upper fish is the juvenile form.) The dark line along the side of the young is generally similar to the coloration of the black-nosed dace. However, the deeper body of the roach, which is greatly compressed behind the anal fin, immediately separates them. The adult coloration is olive brown with a metallic blue iridescence on the dorsal surface. The ventral surface is silvery white. The roach's habit of swimming in schools and suddenly veering in such a way that the sunlight is reflected as a silvery glint, has earned for these fish the name of "shiner."

Shiners are an important bait fish and are eaten by most, if not all, of the larger game fish. They will take a small artificial fly or spoon about as readily as the sunfish will.

Except for their small size and boniness, humans find them quite tasty as a pan fish.

BLACK-NOSED DACE

Rhinichthys atronasus (Mitchill)

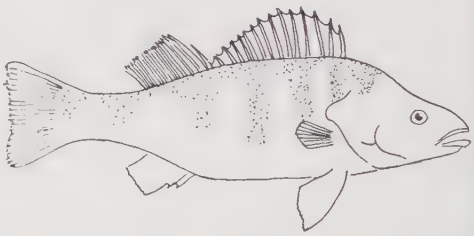
A common fish in our small brooks is the black-nosed dace. It can be found in most of the smaller waterways and sometimes in the pond outlets. Dace prefer shallow, quick-moving water, where they may be seen darting from rock to rock, feeding upon the small insect larvae found in such habitats.

The broad black band that runs along each side of the body extends from the tip of the tail to the nose, and accounts for the name of this animal. During the breeding season the male is tinged with red, and the black stripe takes on a golden edging. Not much is known about the dace's spawning habits.

This fish, four to five inches in length, makes an excellent aquarium animal, provided the water is kept clean and circulating.

AMERICAN PERCH, LAKE PERCH, STRIPED PERCH, YELLOW PERCH

Perca flavescens (Mitchill)



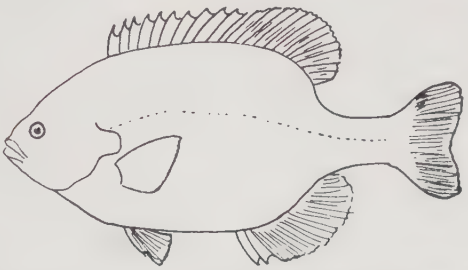
This rather large fish (ten to fourteen inches long) attains a weight of two pounds; however, locally, the average is nearer one pound. It is almost completely a lake dweller. Occasionally small specimens are netted in the streams flowing out of our lakes. Many of our local ponds have been stocked with this fish.

The golden yellow on the sides of the perch, with the dark vertical bar-like markings, make it quite an attractive animal. Its back is dark green and the ventral surface pale. The ventral and lateral fins are reddish or orange in color, particularly in the breeding male.

The food of the perch consists mainly of worms, crustaceans, insects, and smaller fish. It is said that the perch destroys the spawn of other fish and therefore is detrimental to the fish populations. This circumstance, however, is balanced by the fact that young perch are excellent food for bass and other game fish.

The perch has been used in many textbooks as an example of the typical fish. Its prominent fins, symmetrical streamlined shape with characteristic scalation, and gill slits, make it ideally suited for this purpose. It is a close relative of the sunfish.

The perch's range extends from Nova Scotia to the Great Lakes and south to North Carolina and central Ohio. It has been successfully introduced on the Pacific Coast.



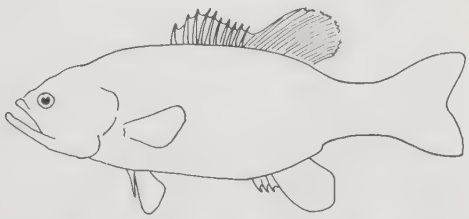
COMMON SUNFISH, PUMPKIN SEED

Eupomotus gibbosus (Linn.)

All of Staten Island's ponds and many of the streams are populated by this small fish (five to six—rarely eight—inches long). Their food consists of insects, worms, crustaceans, and the many doughball concoctions compounded in mother's kitchen by young and old boys.

The egg laying is carried on in shallow water and can be a source of interest to the curious naturalist and the waiting fisherman. The male, in late May or early June, cleans a space on the bottom by fanning away the gravel or debris with his tail, sometimes pulling the heavier stones and other objects away with his mouth. The female is then brought to the nest site and, after swimming around and around the cleared nest, she lays her eggs. These are immediately fertilized by a cloud of sperm released by the male. The eggs adhere to the bottom of the nest because of their gelatinous surface, and the male stands guard over them until they hatch. He displays great courage at this time and will even advance toward one's hand if the nest is threatened.

These fish are excellent pan fish and provide the young "Izaak Walton" with a good fight, particularly on light tackle. Only their small size keeps the veteran fisherman from seeking them. The writer can recall many exciting moments in trying to land these little battlers with a light spinning rod and quarter-pound monofilament. They do not make good animals for aquaria because at breeding time the male will not tolerate other specimens in the tank and mating fights often result in death if the weaker animal cannot escape.



LARGE-MOUTH BASS, STRAW BASS

Micropterus floridanus (Le Sueur)

The large-mouth bass is probably the best known sport fish in this country.

These fish can be found in most of the larger lakes of Staten Island. They occur naturally and have also been stocked by the New York State

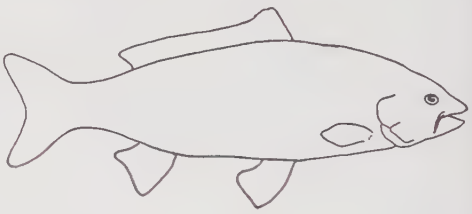
Conservation Department. Unlike their close relative, the small-mouth bass or black bass, they can tolerate much warmer water and therefore are successful transplants into the relatively shallow lakes of Staten Island. The great variation in color in both these closely related species (large-mouth and small-mouth) makes them difficult to distinguish. However, in the big-mouth, the angle of the jaw extends behind the line of the eye—making a good external specific character.

Specimens weighing up to four pounds have been collected; however, the average weight locally is about two pounds. Their food consists mainly of smaller fish, worms, frogs, and insects, and, as their name implies, they can swallow very large prey. They grow rapidly and, where food is abundant, they may attain about half a pound in weight six months after birth. Spawning takes place in June and females may deposit as many as 5,000 young.

The gaminess of this animal when taken on a hook with a light rig rates it high as one of our best sport fish.

CARP, MIRROR CARP, LEATHER CARP

Cyprinus carpio (Linn.)



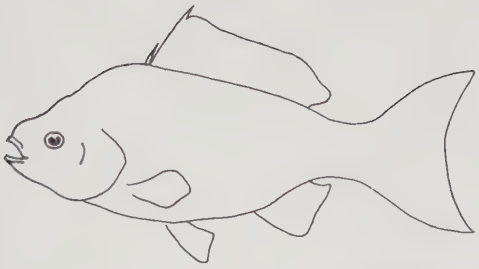
The ability of these animals to live in stagnant as well as clear water makes them one of our common species. They prefer the larger ponds and lakes, where they seek the aquatic weeds and muddy bottoms as suitable habitats. Their diet is mainly made up of vegetable matter. However, they will also readily feed upon the worms, insects, and crustaceans found in these areas. Individuals weighing ten pounds have been seen by the writer. Earlier records reported during the accidental drainage of Clove Lakes, when the dam broke, indicate that specimens weighing as much as twenty pounds were in these lakes.

Although the palatability of the local carp is questionable, they are commonly fished for. A great variety of doughball baits, wheat grains, barley mixtures, and even potatoes are successfully used as lures. Cooking methods evolved by some European races are said to make this animal a tasty morsel.

The carp was originally imported to this country from Central Asia, where it is an important article of diet. Its adaptability and spawning habits (as many as 2,000,000 eggs from a large adult) have well established it in both this country and in Europe. Spawning takes place in the spring and roe can be found in the animals as late as midsummer. The eggs are deposited amongst the vegetation in quiet water.

GOLDFISH

Carassius auratus (Linn.)



The young of the goldfish have normal wild coloring which they gradually lose, eventually assuming the coloration so familiar to us all. These fish are closely related to the carp; in fact, it is believed that they interbreed.

Goldfish, while making a colorful addition to any outdoor fish pool, are also quite useful because the young will eat mosquito larvae. There are many varieties, and, like the carp, they were imported from Asia.

In addition to the above mentioned fish, the following species are periodically stocked in our lakes and ponds by the New York State Conservation Department: pickerel, small-mouth bass, crappie, and the brook, brown, and rainbow trout. These fish offer greater sport to our local fisherman and are soon fished out. In some isolated instances individuals of these species will avoid capture for a season or two. It appears, though, that they have never been able to establish themselves successfully.

The pickerel, which at one time was native to this area, has not been able to reestablish, probably because of the eradication of its typical habitat.

ACKNOWLEDGMENTS

I extend my thanks to Mr. Guinn Polevoy, Game Protector, New York State Conservation Department, for his kindness in verifying some of the preceding data, and also to Mr. James McNeish, who assisted me in much of the field work.

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Fig. 1

MAKING MODELS IN THREE DIMENSIONS FROM QUATERNARY CAVE PICTURES

By

PERCY A. LEASON

Percy A. Leason, well-known Staten Island artist, holds a Fellowship in the Staten Island Institute of Arts and Sciences and also in the Royal Society of Arts. He recently made a trip to France and Spain to test his theory about the cave paintings found in the valley of the Dordogne, where great numbers of the caves are found along the Vézère River. This expedition was undertaken to answer the gnawing question of whether there were convenient heights from which the artist could make his studies of the pictured animals.

Discovered in 1879, the Quaternary art which Mr. Leason discusses dates from about 15,000 to 20,000 years ago. The artists were Cro-Magnon men whose lives depended largely upon their skill in hunting. The animals of that day were mostly mammals, and included the reindeer and the rhinoceros. While kitchen middens are found at the entrance to the caves, there is no further evidence that the artists and their contemporaries made the caves their permanent homes.

The reproductions "in the round" which Mr. Leason has made of the drawings contribute in a valuable way to the understanding of the originals — an understanding which probably could not be found in these explicit terms by any other known method. — Ed.

THERE CAN BE no doubt that prehistoric cave artists of Western Europe turned to the direct study of nature during their Upper Aurignacian and Magdalenian periods. When they did so, their special methods gave rise to one of the great deceptions in art. They chose the fallen bodies of their hunted animals for models and made studies of them while looking down from the cliffs and other rocky prominences in their valleys (Fig. 1). But whereas they saw beasts lying flat, their upright pictures erroneously made them appear to be standing erect. The grass, soil, or rock background was usually left out. As the beasts were dead, the artists indicated nothing for the legs to stand on. There is no evidence of the artist's having had any intention to mislead; it was a case of self-deception on the part of our own generations when the art was first unearthed. Without apparent exception, the archaeologists and others concerned with these discoveries assumed that the pictures represented living, active animals.

During the last forty years, much has been said and written on the supposed virtues of the dynamic art of the Cro-Magnon. The arrangement of pictured legs has long since led to the conclusion that the artists often

intended to show particular actions, such as the walk, canter, gallop, etc. When an artist appeared to have caught some correct movement, not revealed to us until the invention of the camera, learned men were confused by their enthusiasm and suggested that the cave men had more rapid eyesight than we have—a claim that would have been equally absurd if they had referred, more appropriately, to perception. Such errors are still common and some implication of them may be encountered in almost any current lectures or literature on this subject. The great majority of authorities still seem to believe that the artists had an obsession for representing action. They also continue to tax the credulity of the experienced painter by asserting that the cave men worked entirely from imagination. No doubt the assumption is that lively pictures come only from lively imaginations, not from the direct study of nature.

THE FINDING OF THE PICTURES

The young daughter of Senor de Sautola of Santanda, Spain, who first brought the art to the world's attention, may have been partly, although innocently, responsible for our mistaken views. When the Altamira cave was found in 1879, she peered at the dimly-lit ceiling, gradually making her important discovery while her father searched the floor débris for artifacts. The story of how she startled him with her frightened cry of "Bulls! Bulls!" has often been told as if it had been an encounter with living and rampant creatures. This may have influenced others to look for life and action in this art. In any case, it never occurred to anybody to ask whether the pictured beasts were meant to be dead. It was widely and immediately agreed that the reverse was true.

The idea may also have been due in part to the nineteenth century craze for impressionistic action in art. This originated in France about the time of the discovery of the caves, and archaeologists doubtless carried something of this idea into their special field. In consequence, the tendency was to imagine that they perceived this supposed dynamic quality at every turn. Two other factors seem to have contributed to the error: one, the widely accepted notion of how an artist's mind works; the other, the complete failure to consider how the cliffs influenced the course of their art. These cliffs are a striking feature along the rivers and played an important part in the environment of these people.

INFLUENCES UPON THE ARTIST

The functioning of the artistic mind appears always to have been viewed as unique. Nearly all humans seem, to some extent, to be raised with the vague idea that the act of producing a piece of art is not due to efficiency in the same common faculties—sensation, perception, and conception—which gives important achievement in all other avenues of endeavor. The general belief appears to be that, in one respect, the production of a work of art is like a hen laying an egg—an act over which the

mind of the actor has almost no control. For example, when the artist finds a suitable flat surface, he is seized by a subconscious urge, and, behold, there appears his "inner vision" of something; or, in other words, the true artist does not reason; he emotes; he has only to yearn hard enough for such things as a vivid quality of life and they automatically appear in his pictures! This, we have been told by romantics, has been the characteristic of real artists of all times. Of course, we may be sure that not all archaeologists consider all artists as quite such mental incompetents. Yet it seems true that many distinguished men have approached the caves with vague thoughts of dark, mysterious passages—existing in the minds of the artists as well as in the limestone rocks. If the archaeologists looked up while entering, they did so not so much to view the ledges as offering some explanation of the art, as to avoid a bump on the head.

The influence of the cliffs seems never to have been seriously considered as likely to explain the many unique problems of this cave art. Archaeologists have gone to remote places and studied the most primitive races to find solutions which can be found right beside the drawings and paintings. Comparisons have even been made with the artistic fumblings of Australian aborigines. Yet these lowly people, who seldom carried their art beyond a crude outline or colored silhouette, can tell us nothing of how the Aurignacians and Magdalenians developed all three elements necessary to advanced painting—proportion, tone, and color. Other people, like the prehistoric Capsians of eastern Spain, used the two more common elements, proportion and color; but no other artistically minded race except the Aurignacians and Magdalenians gave any sign of being vividly conscious of tone up to the time of Ancient Greece. This means that these cave men were the first fully equipped painters—and they seem to have been the last for thousands of years.

In order to understand the reasons for this, there can be no profit in going to primitives like the Australians, whose mental life was strictly limited by tribal customs and taboos. Giving such customs too serious a significance in art matters might well cause us to underestimate the mental development of the best cave men—as, in fact, already appears to have been done. The obvious truth is that we cannot turn to any primitives in the hope of coming to know the best Aurignacian and Magdalenian artists. We must look more analytically at their work. In this way we may learn much of how they came to take one of their most amazing intellectual steps—namely, the abandoning of the conceptual expression of the first stage of art and the gradual developing of the perceptual practices of the most advanced stage.

THREE DIMENSIONAL MODELS

An excellent approach to a better understanding of both these people and their art is to make models in three dimensions over tracings of Quaternary pictures. This opens up a new avenue of realistic inquiry.

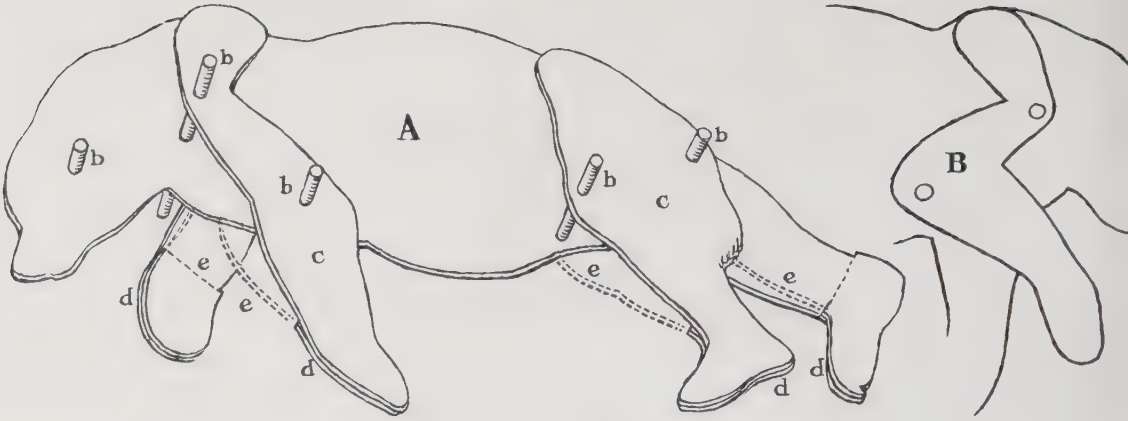

Fig. 2

It is important, of course, to have a reliable reproduction of the chosen picture (see Fig. 9A and Fig. 9B). This should be carefully traced and enlarged to a convenient size (approximately 8″ x 10″) on card. It is then cut out (Fig. 2A). As the modeling will be done on both sides of this card, its shape will determine the outline. The approximate width of the animal at various points, such as the hips, shoulders, etc., is estimated, and wooden pegs to represent these measurements are glued in holes cut in the card at the appropriate places (b). The legs are traced again on to separate pieces of card and, when cut out, each one is attached in the correct position on its particular peg (c). These serve as centre sections on which to model the legs. They are bent so that the respective feet overlap and each pair is glued together (d) in order to preserve the overall silhouette of the cave picture. The first legs are now cut away from the body and feet (e). The whole is then attached to a base on which will be modeled a suitable background of earth, grass, etc. It will often be found necessary to model rocks and uneven ground to accommodate some apparent distortion in body and limbs.

In making such delicate shapes as antlers or horns, it is suggested that plastic wood be used. Each antler is traced on stiff card and when cut out it is carefully pressed into a piece of modeling clay of about three eighths to one half of an inch thick until its surface is flush with that of the clay. The antler is then lifted out and the mould thus left is refined as considered necessary. For instance, the groove for the main stem of the antler can be rounded with a nail or other suitable instrument. When a little plastic wood has been placed in the bottom of the mould, a piece of thin copper wire is pressed in for the full length and covered with more plastic wood up to the surface, to prevent the breaking of the brittle wood when dry. The mould can then be lifted and carefully bent to the desired shape, which can be determined by looking at the animal from the front. A base to the antlers is provided for insertion at the correct place in the head. After 24 hours the rough cast is removed and serves as a core which may be built up with more plastic wood, or trimmed with a knife.

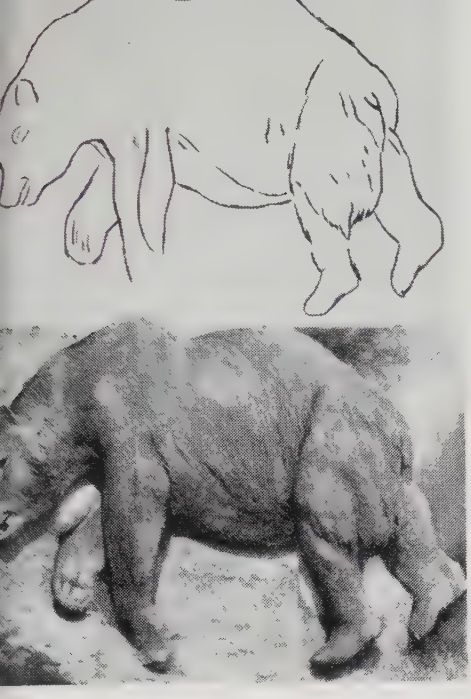

Fig. 3

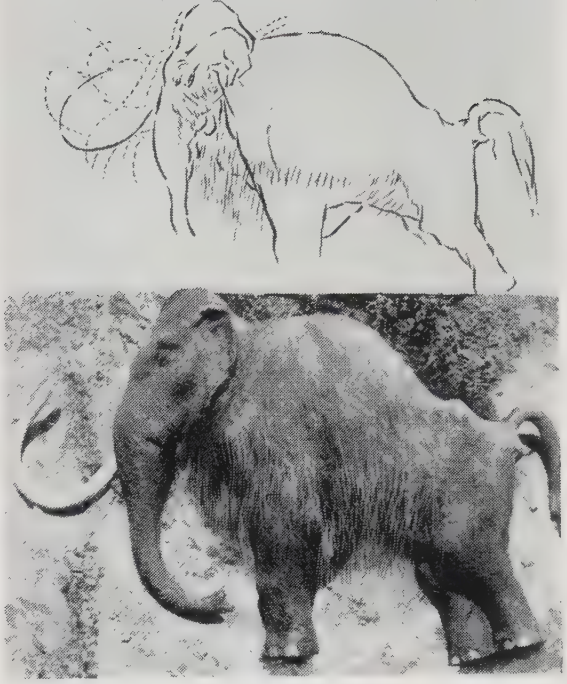

Fig. 4

FACTS REVEALED BY MODELING

Developing a model on an armature like that described (Fig. 2A) is certain to bring many surprises. For example, it will be noticed that the two hind feet of the Combarelles cave bear (Fig. 3)* seem to be of different sizes. But if the forward foot is viewed as foreshortened and modeled in this position, it becomes apparent that the artist recorded what he actually perceived of a prostrate bear. The forward front leg seems too short, but if we take measurements between the joints of the near one, use these for the other and then double it up as shown (Fig. 2B), the artist is again proved, by the convincing result, to be a reliable observer. The same conclusion is reached if we examine the position of the eye and the shape of the lower jaw. The eye appears to be incorrectly placed for a bear in full profile, and the lower jaw seems too fragile. However, these seeming discrepancies are immediately resolved if the head is modeled with a slight turn toward us and an upward tilt of the muzzle. This brings the eye into the correct position. It also shows that the drawing does not give a full profile view of a bear's lower jaw; its nearest edge is seen from a little above. A subtle twist occurs in the beast's hindquarters, and this is explained with complete conviction if the carcass is modeled on uneven ground with the spine bent upward toward the tail.

Dramatic revelations come from the so-called "Charging Mammoth" (Fig. 4). After making a model from this drawing, there remains little doubt that, far from charging, the unfortunate mammoth was actually drawn while in the throes of a violent death. The model suggests strain

* This and similar figures show the drawing above and the model below.

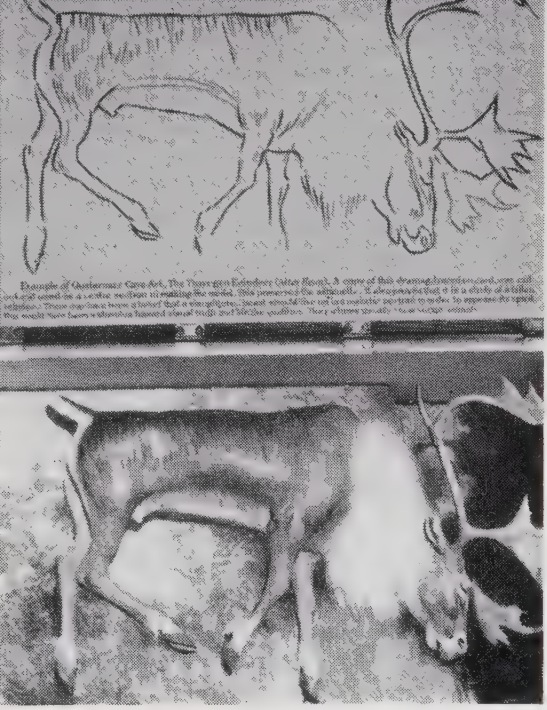

Fig. 5

Fig. 6

and internal injury, and we seem to be witnesses to the end of a stampede over the cliffs of La Madeleine, where the drawing was found. The fall may have broken the nearest tusk; it is missing, and the drawing was made on mammoth ivory. The lifted tail may have suggested charging to romantic writers, but the anal prolapse denies it. Some discharge of faeces is indicated in the original—a phenomenon common to recently dead beasts. The backbone appears to be fractured; the hindquarters are sufficiently distorted to bring the hip bone well above the line of the spine. One lifted foreleg may also have indicated charging to earlier writers, but it seems to be lifted too high and is equally convincing if viewed as broken and crumpled.

The famous reindeer (Fig. 5) found at Thayngen in Switzerland contains nothing of the commonplace and it is certainly not a "browsing reindeer" as was formerly supposed. It lies dead with its head on a ledge, so that the further antler shows its brow tine, or lower half, and allows the head to lie flat. The upper half of this antler is missing, and part of it may have been used as a surface on which to do the original drawing. Among the most unusual features in the drawing are the legs and feet. They carry no weight of the body. It is plain that it was not the artist's intention to show a standing animal; any hunter would know that if this animal stood on yielding ground the two straight legs and feet are in a position to sink. Both of the nearest hooves show their undersides. In both legs there is a complete absence of any suggestion of muscular tension, indicating they are obviously the inert legs of a lifeless animal. The head, splendidly drawn, confirms this, with its subtle suggestion of stillness and of being turned slightly away, which may be indicated by the position of

the lower antler; but, while this contributes to the effect, it will be noticed that the head retains the same effect even if the antlers are covered.

Another remarkable reindeer is the beautiful study in proportions and tone from Font de Gaume (Fig. 6). This affords a somewhat amazing demonstration of the curious but unavoidable facts which are revealed in making a model. If we had to believe that the cave men worked entirely "from imagination," we would also have to believe that the particular man who pictured this reindeer was given to astonishing perversity and fancies, bordering on the imbecile or at least the fantastic. Consider the two forelegs. The nearest one seems at first to be missing and the impression is of a three-legged beast, while the other foreleg is strangely short and appears to be withered. But these doubts, however strong, begin to vanish as the model develops; the whole figure, with its seemingly wild arrangement of forelegs, becomes quite reasonable and natural if we view it as having died with its head and lower foreleg resting against a bank which rises toward us. It was only when it was viewed in this way and modeled at an angle of forty-five degrees to the level of the prostrate body that it coincided with the silhouette of the original. This leg, of normal length, was therefore viewed by the artist as foreshortened, with the foot rising toward him.

After an evening of modeling and new doubts of the correctness of these strange findings, they were verified next morning by a startling event that seemed to bridge the vast time and bring the cave artist close. Also, a new avenue of speculation was indicated. The model and reproduction of the original were taken to the outside porch, and when the window shade was raised the February sunlight fell across the model. By an accident the position was right and the light and shade effect was almost exactly that of the original. Even the foreshortened lower foreleg proved its position correct in the model; the foot cast its shadow over all but a narrow hind strip of the leg as in the painting.

The other foreleg lies near the belly and slopes down to the ground. Its position entails no distortion and seems most natural for a dead beast. It could have been held there by gravitation, assisted perhaps by a chance rock, as in the model. The foot could have been hidden in grass or other cover, and this would account for the fact that it does not seem to be indicated in the original picture. The artists often appear to have left out what they could not see of their models, because of some obstruction.

It is strongly suggested by the winter sun mentioned above that this reindeer was lying in snow and the leg was partly buried. Although it may appear to be carrying conjecture too far, this is the best explanation of the lost foot and confused leg. The light fur of the inner part of the leg would make little contrast against the snow, and this would leave the artist nothing to state—unless, of course, he referred to his concept of a reindeer's foreleg. This he appears to have refused to do. Our model shows a bed of snow, but with the questioned leg and foot uncovered.

While this model was being photographed in sunlight by Robert Mathewson, Curator of Science of the Staten Island Museum, some difficulty was experienced with the shadow of the near antler. Mr. Mathewson suggested that the second antler depicted in the original may have been merely a shadow of the nearer one, and that the other antler may actually have been buried in the snow. Experiment with the model seems to bear this out, as indicated in Fig. 6. Note the double prong of the first tine, projecting toward us, and the single point of its shadow, as in the original.

It seems to have been a common practice to place long-horned animals in such a way that the lower horn hung over a ledge, thus permitting the head to lie flat; but this may, of course, have been due to chance. The examples which have been found could have been pictured as they fell in the characteristically rough terrain. In many parts of the Vézère and Dordogne valleys, cliffs and scattered rocky areas are found at every turn, and one often scrambles around with difficulty on leaving the roads. With smaller animals such as the ibex (Fig. 7), the subject could have been dragged the few feet to a suitable position from which the artist could look down and make his study. It was first assumed that this excellent sketch represented a living ibex and was made perhaps while the animal stood looking out from behind a rock; however, experiment showed the drawing to be equally convincing if made from the animal lying dead. Of one thing the experienced painter and illustrator is certain: it is no work of imagination, but a simple, direct study of either a living or a dead ibex; and it was made for the sake of art.

THE "GALLOPING BOAR OF ALTAMIRA"

A subject of particular interest for modeling is the famous so-called "Galloping Boar of Altamira" (Fig. 8 and No. 10 of Fig. 9A). It is stopped in its tracks by the act of making the model. It cannot stand. All suggestion of action vanishes and a carcass lies before us, as it did before the Upper Magdalenian artist. Like so many others, it is a remarkable demonstration of artistic objectivity, in spite of some signs of stylization in this case, and other hints that the art may have commenced to decline. Many seeming errors prove to be simple statements of truth. There is, for example, a curious twist in the trunk, the forequarters leaning toward us while the hindquarters lean away. There must be extreme doubt whether any prehistoric human could have clearly perceived such a rapid movement if it occurred in a living, galloping beast. He might have been vaguely aware that it happened, but he would certainly fail to perceive precisely what parts of the body were affected, and how. Such things were not revealed to us until the coming of the once-famous Muybridge photographs. We have only to look at horse-racing pictures of the first half of the last century to appreciate the greatly increased and subtle knowledge of action that came to illustrators with the moving-picture camera. This, however, was beyond the ken of prehistoric cave artists. But there need be no mys-

Fig. 7

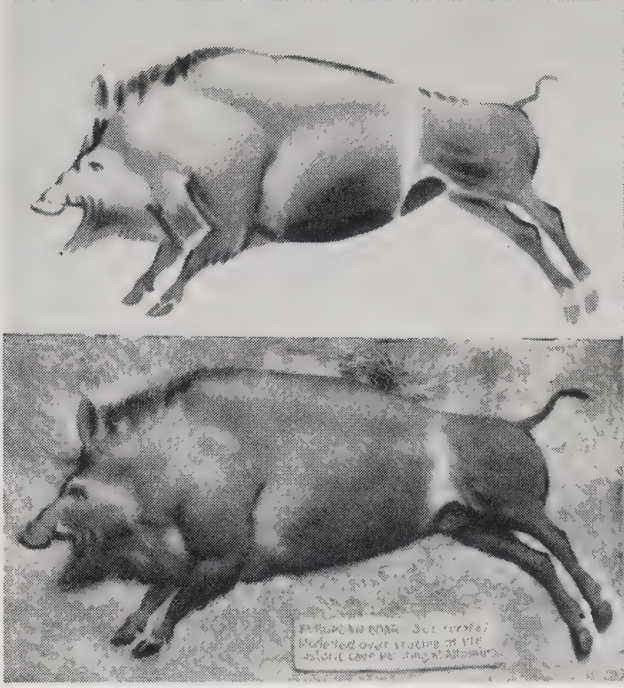

Fig. 8

tery as to how the twist came into the body of the painted boar if we reflect that this kind of thing commonly occurs in a carcass lying on uneven ground. We should also realize that, once more, an Upper Magdalenian painter was so little interested in depicting natural action that he made no attempt to indicate that his boar's feet were supporting anything.

The majority of Quaternary cave pictures promise surprises in making models from them. In almost any one of the examples in Fig. 9 not yet modeled, we can safely anticipate some unusual turns in the body, head or limbs. No. 1 of Fig. 9A seems the only exception, but even this might prove to be a little more convincing lying dead. But what would we have to do to No. 29 of Fig. 9B to make the legs seem more natural in their positions while retaining the same outlines? This is the so-called "Wounded and Falling Reindeer" of Limeuil; but it is safe to say that the model cannot develop far before the title will be proved in error.

This can also be said with confidence of No. 27, the "Deer Crossing a Stream," from Lorthet. The relaxed feet of all three animals have nothing of natural action about them. The leading deer holds its hind feet together in a most aimless fashion and the further foot comes down to a lower level than the other, as it commonly does in a carcass lying flat. The modeling of the rear stag should indicate that the artist turned back the head of his dead model by using the antlers as a prop; this simple device worked perfectly while photographing a fallen stag to illustrate an earlier paper on the subject. The fish probably suggested the original title; and it is intriguing to speculate on the reason for their presence in this beautiful drawing. But it may simply record an unusual catch or refer to a forthcoming banquet.

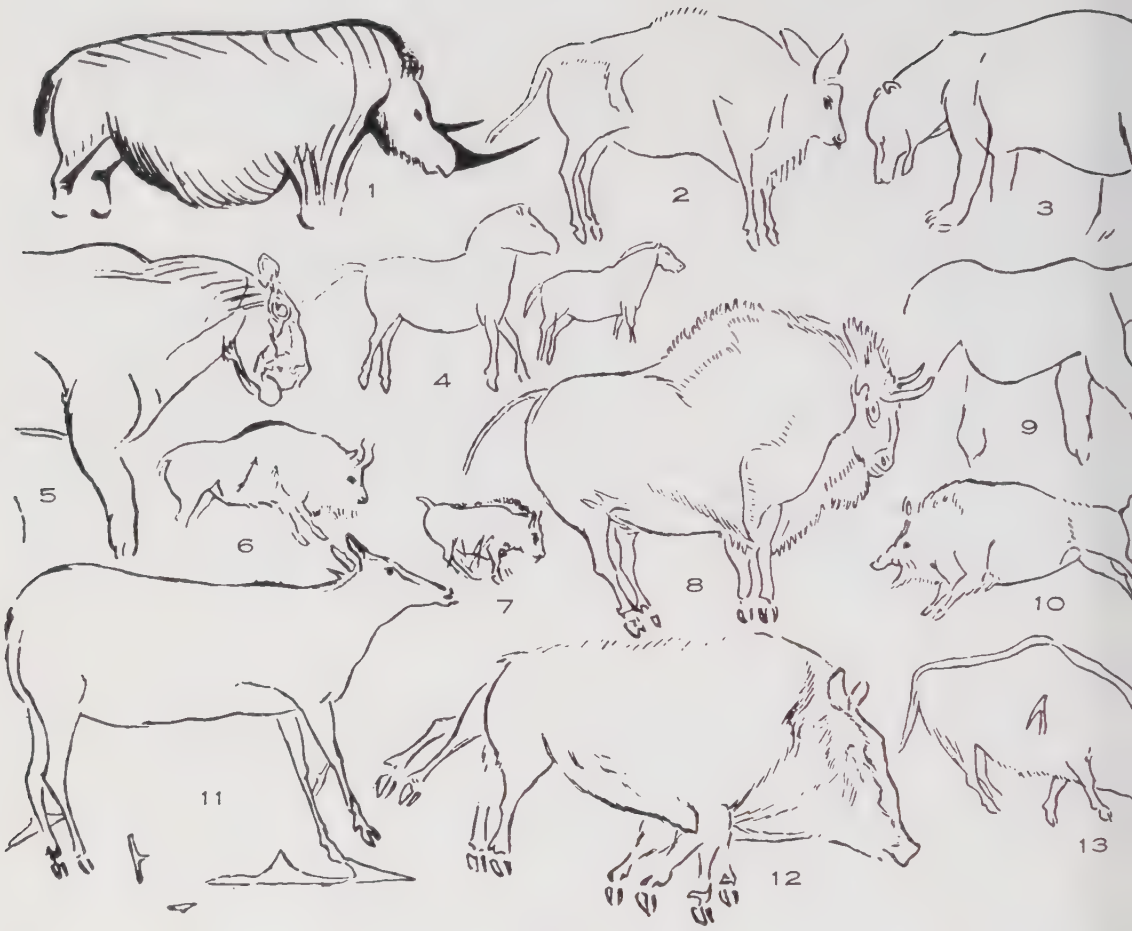

Fig. 9 A

Fig. 9 A

1, Font de Gaume woolly rhinoceros; 2, Altamira bison; 3, Teyjat bear; 4, horses from Teyjat group; 5, Combarelles feline; 6, Niaux bison (*after Baldwin Brown*); 7, bison; 8, Altamira bison; 9, bear from Teyjat group; 10 and 12, Altamira boar; 11, Altamira hind; 13, Pindal bison.

Fig. 9 B (*opposite*)

14, St. Marcel reindeer; 15, Font de Gaume pony; 16, Combarelles cave bear; 17-19, Teyjat reindeer; 20, Limeuil reindeer; 21, Niaux bison; 22, Teyjat reindeer; 23, Teyjat bull; 24, Teyjat cow; 25, La Madeleine mammoth (*after E. Lartet*); 26, Teyjat reindeer; 27, Lorthet group; 28, outline sketch of relief carving (*after Breuil*); 29, Limeuil reindeer; 30, preparatory engraving underlying one of the Font de Gaume polychrome bison; 31, Limeuil ponies; 32, Niaux horse; 33, Thayngen reindeer (*after Heim*); 34, Limeuil reindeer; 35, Altamira bison.

NOTE.—Unless otherwise specified, tracings of subjects from Niaux are *after Breuil and Cartailhac;* from Combarelles, Font de Gaume, Altamira, and Limeuil *after Breuil,* and from Teyjat *after Breuil and Capitan.*

Tracings from paleolithic art, mostly from southwest France and northern Spain (*after Breuil and others*).

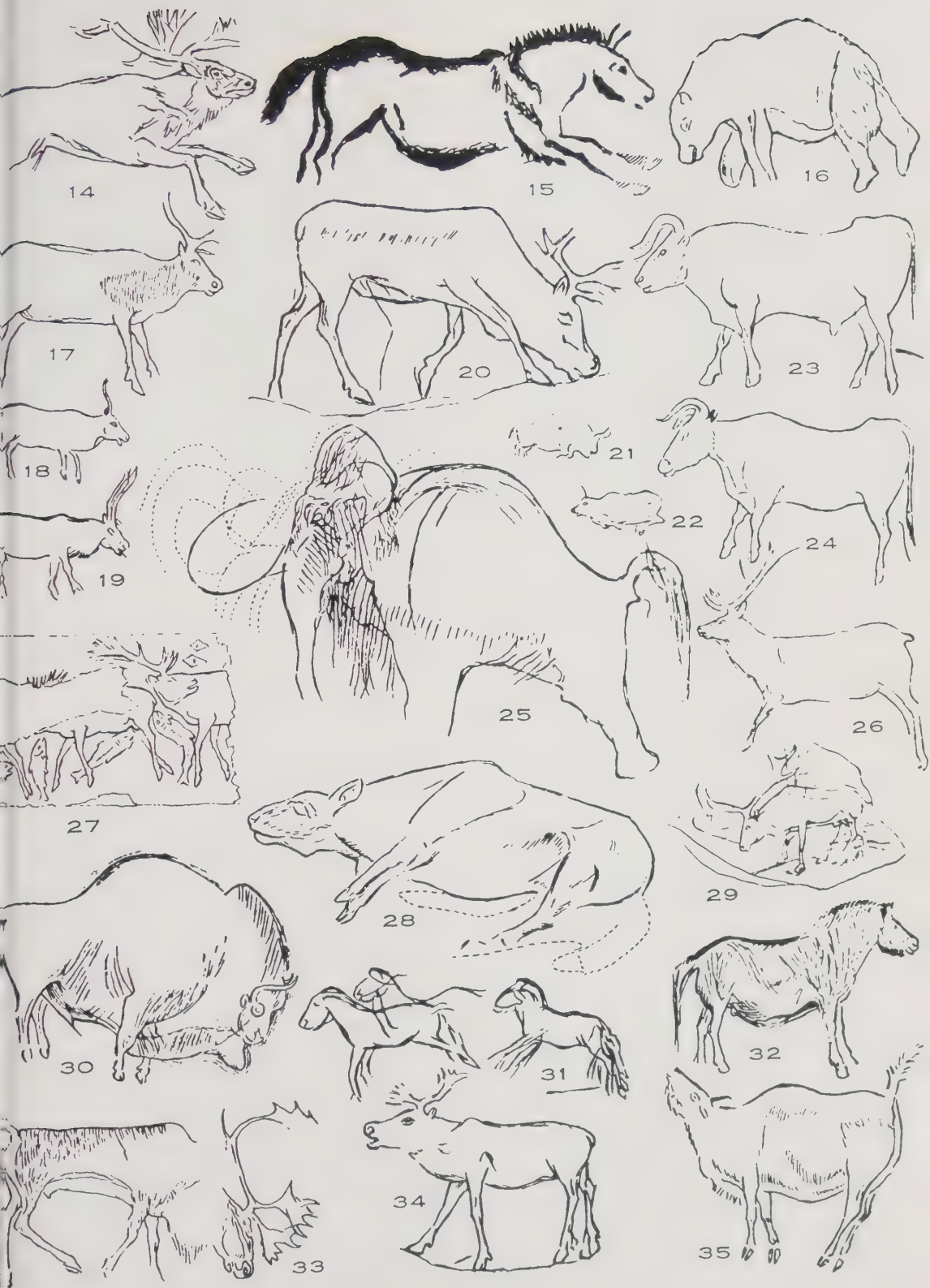

Fig. 9 B

No. 12 of Fig. 9A, the "Galloping and Standing Boar" of Altamira, is another whose title would become manifestly absurd after making a model. No matter which four of the eight legs were chosen, the boar would seem equally dead; none of the feet could be made to stand firmly in an upright beast without important alterations to their positions. Moreover the weight of the head and forequarters would seem to need an additional prop to prevent it from falling forward. If we chose to model the hinder two pair of legs, the result would certainly be a representation of a boar which was either taking a complete rest or had made its last gallop.

The making of a model dramatizes the startling fact that the large hind of the same cave has almost no neck (Fig. 10, which is also No. 11 of Fig. 9A). Certainly it lacks the slender grace of a hind's neck. However, the puzzle is resolved if we view it as having been painted in sharp perspective, with both head and neck hanging away from us, over a ledge. This fits in with the careful observation that went into the rest of the picture. The hanging head explains the projecting tongue; the weight of the head and neck pull on the nearest shoulder; this in turn tends to lift the foreleg and drag the hoof over the surface on which it rests. In this way, we have the explanation of a remarkable feature—the peculiar separation of the two halves of the hoof. This occurred like the separation of fingers in the hand of a dying human grasping for support. The accurate following of the painting compels such effects.

EFFECT OF LIGHT ON A MODEL

Facts of great significance are sometimes revealed, often by a change of the light on a model, as with the Font de Gaume reindeer. The same thing occurred with the so-called "Bellowing Bison" of Altamira (Fig. 11 and No. 35 of Fig. 9B). This excellent painting shows two sources of light, one diffused and coming from the direction of A (Fig. 11), and another, more direct, coming in very low from the direction of B (Fig. 11). The accident of how the model was placed while work proceeded, revealed that this was precisely what was observed when the original study was made. The main source of light came from the general dome of the sky; the low light came from a rising or setting sun. The latter effect on the model was improved by lifting the near hind hoof and modeling a rock for its support—the raised leg thus permitting more light to reach the lower edge of the belly and neck, as shown in the original. Other adjustments, such as the raising of the further foreleg and the lowering of the other hoof made similar improvements, proving that this effect of light and shade did not come from any human imagination but was determined by the accidental arrangement of planes in a dead bison. Even a slight alteration in the direction of the light from B (Fig. 11) upsets the effect. This makes it clear that the artist suppressed his concepts and simply tried to understand and paint what lay before him. Not only is this self evident, but no other kind of painter would have given us the seeming incongruity of a full view of the underside of one hoof in this otherwise profile beast.

Fig. 10

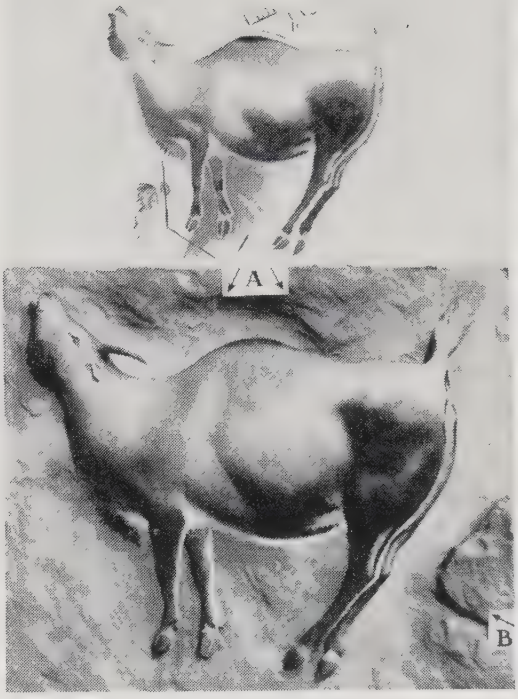

Fig. 11

Something unusual for a living animal would be revealed in modeling such examples as Nos. 7, 11, and 19 (Fig. 9A and Fig. 9B), which project their tongues. At least a dozen more drawings from the caves show animals in the act of doing this. But it is safe to predict that modeling any one of these would soon bring to light strange features not readily apparent, and which could not be called faults on the part of the artists.

TRANSFER OF DIRECT STUDIES TO CAVE SURFACES

While all Aurignacian and Magdalenian pictures come under the heading of cave art, many were made on small stones, or pieces of ivory or bone. Some of these were not even found in the caves. We may be sure, in fact, that most of the art was practiced in the open daylight. Because of the high quality of the best examples, experience compels the belief that production must have been enormous. Hundreds of studies by the same artist must have preceded the Altamira hind or bison, for example. This is true of every other comparable piece; very few may reasonably be regarded as "first works." Nevertheless, there remains—in the minds of laymen, at least—a vexing question of how pictures found on the cave walls were executed in such dark and difficult places.

In many cases, where conditions are not known to us, we venture no guess; but it can be said that often the puzzle is not so real as it seems to be. There appear to be few—if any—pictures that could not have been executed, under the same conditions, by a well-trained artist of today. For instance, there is no mystery in a small horse being drawn upside down on a surface in a cramped and dark passage if we remember that the artist

may have just come in from making a direct study of a dead horse lying with its back to the foot of a cliff on which the artist stood to view it. Since the animal was studied upside down, the artist merely repeated what he had learned.

However, it is quite impossible to believe that the large hind of Altamira, said to be seven feet long, was "painted directly on the ceiling in perfect proportions." This would indeed savor of magic, since such a feat would exceed all known human limitations. The ceiling is so low that a man of average height cannot stand erect; even lying on one's back on the floor does not make it possible for one to view the hind as a whole. A realistic and practical guess is that since the artists were intelligent enough to devise the materials for their art and to do such remarkable work, they were wise enough to think of the obvious method of transferring their pictures to the cave walls as accurately as possible.

If the artists regarded a study as worth preserving, they first enlarged it carefully in daylight on prepared skin. This gave them space to step back to view the enlargement as a whole and so control the proportions. Then they took the skin into the cave and, having rubbed dry pigment on the reverse side, they placed it in position and traced down the outlines of the main features. In case the helpers should allow the skin edges to move, they were marked as we marked the edges of our tracing paper on the lithographic stone in our apprenticeship days. Such marks may be observed painted around the large hind and the bison (Fig. 10 and Fig. 11). Where they cannot be found, the artists may have removed them after they had served their purpose. With the tracing completed, color and tones were filled in by referring to the original study. As for light, skilled artists of our own time would find one or two candles sufficient to do what the cave men did with their animal-fat lamps.

WHY PICTURES IN CAVES?

We can only guess why some of the work was done in the caves. Many archaeologists believe that the paintings were used by medicine men to secure a magical hold over the animals that were to be hunted. But while this theory may apply in certain cases, it fails completely to explain the all-important fact—the development from crude, infantile outlines to splendid proportions and full tone and color of considerable refinement. The Australians and other lowly people demonstrate that magical practices do nothing to develop art, since the weakest kind of pictures will serve witch doctors in duping uncritical tribesmen. All progress in art comes from the artists' desire for better art.

The truth is that various reasonable arguments may be advanced to account for the pictures in the caves. Much fine work must have been lost through being painted on such perishable surfaces as skins, and this may have led some artists to prefer the cave walls as more permanent. We may

be sure that the desire to preserve one's best achievements was just as strong then as at any other time in human history. Again, if we must give an important place to magic, there may have been a belief that the drawn or painted image of the slaughtered beast must be preserved in order to appease its spirit. Such images would survive longer in the caves. Or perhaps self-styled art critics arose amongst the witch doctors and they declared the leading artists far too adventurous and realistic for the spiritual good of the tribes (as they do today!)—so they drove them underground. If that is actually what happened, the tyranny was our good fortune; we might otherwise have known little of this first great epoch of painting.

SUMMARY

The art of making pictures commenced with these cave people, as it must commence with any other people at any time, as a truly primitive thing. If we remember this obvious fact, so much overlooked at present, we may learn a great deal in making the models.

The best cave artists, during their centuries, anticipated the basic steps taken in such great epochs as the European Renaissance of the thirteenth to the seventeenth centuries. They ended with virtually the same viewpoint, in its main features, as that of Velasquez, Rembrandt, Hals, and others. The important truths which are made clear are:

1. Their art commenced as the expression of concepts of things—the digest of what they had learned from past experience with the particular thing they tried to picture; they drew like children, with no interest in what might be before their eyes at the moment, apart from the picture, but with the focus on what was already in the mind. This could be expressed with outlines alone, as in a modern comic strip. Some development of this form was the limit of the art of their near contemporaries, the East Capsians. This was pure *conceptual art.*

2. They continued this form but gradually improved it by turning to make direct observations of the particular thing they tried to picture; if it was a bison, for example, they looked up when in difficulty with their drawing, to observe a real bison; thus they gradually learned the advantage of reinforcing their pictures with perceptions; they did more and more of this as time passed and in this way their art became more like nature. This was *conceptual-perceptual art.*

3. By some lucky chance, they came eventually to do nothing else but make direct studies of the particular things they wished to picture; in this way they were expressing only perceptions derived from the particular experience of seeing (as in the reindeer, Fig. 6 and others); and they eventually developed most of the refinements of this practice which led to a fuller appreciation of the law of relationships existing in natural proportions, tones, and colors. This was pure *perceptual art.*

The claim that the best cave artists achieved this third form I believe to be beyond dispute. An excellent proof is the capacity of the trained perceptual artist to avoid falling back on concepts when perception fails. There are many examples of this in cave art, for instance: the confused leg and foot beneath the belly of the Font de Gaume reindeer, Fig. 6; the lost edges in the Altamira boar, No. 12 of Fig. 9A; the lost edges above and below the neck of the Thayngen reindeer, Fig. 5. These are only three examples; but, even if there were no more, their places of execution were scattered over hundreds of miles, thus proving that a high form of discipline had occurred and was by no means uncommon.

In view of the foregoing data, we are compelled to believe that the principles of perceptual art were taught and that artistic discipline was carefully developed. Only in this way could the artist have controlled the natural impulse of the human individual to take the line of least resistance when in difficulties. This is the commonest of all tendencies in the art of painting, and there seems to be no reason to suppose that the disposition was ever different. The experienced teacher knows well the tendency of the beginner to be dominated by his concepts, the irresistible urge to put in edges he cannot perceive, and otherwise explain nature when there is a lack of visual clarity—and the dread "tightness" that results. Nor is this difficulty confined to "raw" beginners; the person of high and special education often finds it impossible to overcome. The anatomist, with rich and complicated concepts of anatomy, makes an exceedingly difficult student of portraiture until he learns to suppress his anatomical concepts. The botanist art student paints dull and tedious pictures of flowers until he has decided whether he wishes for the moment to be a botanist or an investigator of visual reality. If the latter, he must, for the time, forget his botanical concepts and remember his perceptions of the visual appearance of certain particular flowers. What is confused or lost? Where are the clear, sharp accents? Such things are worth knowing, for they cannot be invented by any man better than nature displays them. This thought may or may not have occurred to the best cave artists.

But whether it was clear or otherwise, they encountered the ever-present conflict between the intellectual desire to state only related perceptions and the emotional impulse to do the easier thing and "finish" the picture by expressing facts and fictions from one's concepts. We surely need no more than a rough, working knowledge of psychology to realize that conceptual art (or "working from imagination" or "out of the head") is child's play and the commonest form of art; it floods the world with "geniuses" and millions of their products. On the other hand, perceptual art is as difficult as any other objective study and quite rare. In the whole of history it has occurred only four times in its purest form, during the great epochs.

Here, then, was the amazing achievement of the best cave artists: they were raised in the lore of hunters, with a mass of highly developed

and complicated concepts of animals on which their lives depended. Yet with apparent ease they managed to suppress these concepts completely and give us instead very truthful studies of the visual appearance of animals, with nothing else added. We must remember that they lived at a very early time when men were ridden by superstitions and taboos, when intellectual development was subject to great handicaps. Thus it becomes obvious that they must have had some special condition which has seldom, if ever, come into the environment of other artistically minded people.

CLIFFS AS VANTAGE POINTS

This unusual condition was the presence, at every turn, of cliffs and other rocky prominences along the waterways. From these vantage points the artists commenced to make studies of animals lying dead below them. Perhaps some lookout, watching for migrations, may have chanced to look down and study a recent kill and was then impelled to try to draw it. In any case, the practice soon became common and brought a new vitality into art. Because of this, the gradual development of pure perceptual art was merely a matter of time, plus a natural desire for still more vital art. As we have said previously there may even have been a superstition behind it, that the image of a slaughtered animal must be preserved in a picture as perfectly as possible, in order to appease its spirit. This would indeed have been a strong stimulus for the art.

But the most important point is that the use of the cliffs and ledges in this way brought almost perfect conditions for the practice of a high form of realistic art. With an average height between thirty and a hundred feet or more separating the artist from his model, he was, to some extent, compelled to view it as a whole. This would be especially true as the distance increased. The artist could take in the whole of the subject without moving his eyes. In most cases it would have required an effort to review it bit by bit, detail by detail. Without doubt, this is one of the finest virtues displayed by these cave men; they seldom gave tedious detail, or what may be described as a tick-bird's view of an animal.

With the long view from the cliff position, it would again be only a matter of time before the artists would become as much conscious of natural color and light and shade as they were of proportions. These would often be striking and beautiful parts of the effect they contemplated and were trying to achieve. If the light and shade confused the shape or edges of body and limbs, as it would often do, the flint tool, with its inflexible point, would soon prove itself useless in the attempt to convey the effect. A smudge of charcoal, or even a soiled finger, would be more subtle and effective. No doubt something like this brought the awareness of the value of tone. This led to the serious investigation of this element that is found in many examples from the Magdalenian period.

It also led to another remarkable step, not taken by any other race of artistic "primitives": this was the abandonment of outlines as unnecessary

and visually untrue. Clearly they found them a handicap in trying to conquer a visual effect. Experience was well on the way in teaching them what Velasquez learned many thousands of years later—that it is better to arrive gradually at necessary hard edges where they occur, than to commence with them, in outlines, where they do not appear.

There is no puzzling feature of the art which cannot be reasonably explained by the artists' cliff position while at work. This offers the simplest explanation of how they made their change over from conceptual to perceptual art. They were probably not even aware of the change, or of making it, after initial difficulties had been overcome. There appears to have been ample evidence that, like most other artists, they could, without effort and pain, return to old conceptual ways. Thus when they reconsidered a beautiful painted figure like the Altamira boar (No. 12 of Fig. 9A), in its original state, they probably thought that it too far outraged their concept of a boar with normal legs and normal ways. So they painted out the old legs and conceptually painted in a new lot.

We know that in the Late Magdalenian Period perceptual art was dropped, perhaps because of a new interest in decoration. The work became wholly conceptual again. The artists, with the usual self-satisfaction of the sophisticated, turned their minds inwards completely and thus became blind to the source of former strength. Without the sustained enthusiasms of any deep convictions, and repeating themselves over and over, they soon provided little excitement. The people finally lost interest and the art died.

FURTHER REASONS WHY CERTAIN EXAMPLES MUST BE REGARDED AS PERCEPTUAL ART

In the review of the Thayngen reindeer (Fig. 5) on page 58, reference is made to the curious arrangement of legs: "Any hunter would know that if it stood on yielding ground the two straight legs and feet are in a position to sink." This inclusion of all hunters must seem reasonable to anyone. It is hardly necessary to say that any hunter, even of moderate intelligence, would know the basic facts involved in the act of standing. His own everyday experience would surely give him an adequate concept of this. We must assume that most Aurignacian and Magdalenian hunters had feet of their own and must, at some time, have walked in marshland or even plain mud. Certainly they would have known what must be done with feet when walking in deep snow.

Moreover, any hunter depends on reliable concepts of the animals he hunts, and these include the kinds of tracks they make. If some new species ventures into his territory, he seeks at once a knowledge of its ways and often begins by a study of its footprints. The primitive hunter's life, and that of his tribe, sometimes depends on the development of a complicated sum of truths which come from his own hard experience, plus that of the elders. The Australian aborigines, for example, are so conscious

of animal tracks that children are trained from infancy to identify them. Some tribes often pictorially represented animals by their tracks alone.

Since this special interest is found with all hunting peoples, it is absurd to believe that an artist-hunter, taking great pains to state the truth while drawing out an animal from his concept, would ignore it when he came to the feet. Can we credit such perversity—such extreme indifference to those truths on which life itself might depend? It appears almost instinctive for the individual to battle for those parts of a concept which seem most certain. Even non-hunter archaeologists show this tendency: surely they are defending their own concepts of what is involved in standing, by the familiar criticism that cave artists gave their beasts no ground to stand on.

Most concepts of animals seem to preserve the common facts pertaining to everyday behavior, etc.; unusual facts invariably take a minor place, or are forgotten. We may once have watched a falling dog hit the ground with its head during an accident, but the fact that this was possible for that dog plays a small part in our concept of the dog, unless we are reminded of the incident. An illustrator does not draw all of his horses with a broken foreleg because he once happened to witness such an accident. If a cave artist, by some freak, once watched an animal perched on its hoof tips and rigid legs, can we reasonably suppose that his influence might introduce this as a fashion in animal pictures? We must draw the line somewhere, for our concepts of life and of humans would compel us to believe that the artist's fellow hunters also had reliable and perhaps more respected concepts of animal behavior. Ancient Egyptian wall drawings indicate what usually happens in conceptual art. All the animals stand firmly on flat ground with bent fetlocks, and their general behavior is that of the farm, the market place, or the hunt. They never behave like the bison, No. 35 of Fig. 9B.

Tiptoe feet and straight, stiff legs are sufficiently common to be described as a characteristic of cave art. Therefore the artists did not draw such things from their concepts as digests of past experience. They came into the art because the pictures were direct studies of dead animals.

THE AUTHOR'S DEFINITION OF CERTAIN TERMS

Sensation, sense data: The product of sense organs. It ceases to exist when the stimulus which produced it ceases to operate on the sense organ.

Perception, percept: The product of the perceptive faculty in its reaction to sense data; a mental occurrence giving awareness of a thing or things present.

Conception, concept: Any accumulation of facts and/or fictions relating to a thing or class of things, conceived as a digest of past experience.

Primitive: Early, undeveloped; the first or initial form; the beginning stage; direct opposite of the mature or relatively perfected.

CHRISTMAS BIRD COUNT

The following count was taken on December 21, 1958, by seven observers, who saw 24,171 individual birds and noted 52 species:

1 Red-throated Loon
4 Horned Grebe
5 Double-crested Cormorant
9 Mallard Duck
34 Black Duck
17 Canvasback
1,726 Greater Scaup
75 Common Goldeneye
37 Bufflehead
8 Oldsquaw
7 White-winged Scoter
5 Red-breasted Merganser
3 Red-tailed Hawk
1 Rough-legged Hawk
8 Marsh Hawk
8 Sparrow Hawk
25 Ring-necked Pheasant
1 Clapper Rail
3 Killdeer
4 Common Snipe
20 Sanderling
447 Great Black-backed Gull
15,866 Herring Gull
314 Bonaparte's Gull
3 Mourning Dove
1 Flicker
10 Downy Woodpecker
72 Horned Lark
2 Tree Swallow
17 Blue Jay
453 Common Crow
9 Black-capped Chickadee
4 Tufted Titmouse
3 Robin
4,399 Starling
2 Myrtle Warbler
127 House Sparrow
1 Eastern Meadowlark
125 Red-winged Blackbird
7 Rusty Blackbird
15 Common Grackle
90 Brown-headed Cowbird
38 Cardinal
10 Pine Siskin
1 American Goldfinch
40 Slate-colored Junco
22 Tree Sparrow
43 White-throated Sparrow
4 Fox Sparrow
3 Swamp Sparrow
40 Song Sparrow
2 Snow Bunting

The seven observers were:

Howard H. Cleaves
Barbara Cook
Mr. Heillrun
Casimir Redjives
Jack A. LeMaire
Clara Taylor
Mathilde Weingartner

BOOK REVIEWS

INSECT MIGRATION, by C. B. Williams. The Macmillan Company, New York. 1958. $6.00.

The thirty-sixth publication in the series of "The New Naturalist Library," this book maintains the high degree of competence that preceding publications in the series have led us to expect. The subject of migration necessarily transcends national boundaries, giving this work an even wider appeal than some of its predecessors which considered problems peculiar to the British Isles.

Dr. Williams was a solitary pioneer in this neglected field of animal behavior. For many years he carefully compiled field data on insect migration which was a prerequisite to the formulation of theories concerning the reasons for migration, and the mechanisms, navigational and otherwise, by which it was brought about. Dr. Williams' appointment as an entomologist in the Colonial Service afforded him the opportunity to travel widely in the tropics where the mass movements of insects are more frequent and more conspicious than in the British Isles. It was as a result of his observations on migrations of lepidoptera and later of locusts that the scientific world first became aware of the problem of insect migration. He was aided considerably during this phase of the study by the observations of many amateur and professional naturalists which related chiefly to the periodic movements of butterflies and moths. It remained for Dr. Williams, however, to integrate these observations, and an earlier result of these efforts was published in 1930 as *The Migration of Butterflies.*

The present book has two main divisions: first, a consideration of the kinds of insects known to migrate and the routes they follow; second, and even more interesting, a consideration of the problems of the "how" and "why," the means of navigation, the stimuli that initiate migration, and the effects of migration on the species. Dr. Williams does not consider a return flight to the original habitat to be an essential part of the definition as is usually the case with the much more extensively studied migration of birds. An entire chapter, however, is devoted to the problem of the return flight as exemplified by our familiar Monarch butterfly. It is the author's belief that return flights are more common among migrant species than is realized, but that due to their wide dispersion they are difficult to observe. He has, rightly or wrongly, bolstered this opinion by a recourse to natural selection and reasons that a non-return flight, which can only result in the loss of individuals from the resident breeding population, is a detriment to the species and, therefore, would be eliminated by the forces of natural selection. Of particular interest to naturalists and bird-peepers is a short chapter comparing the migration of insects to that of birds and other animals. No fundamental conclusions can be reached, however, as the mechanisms concerned are almost as much of a mystery among the

vertebrates as they are with the insects. It might have been of interest to consider the possible relation of Von Fritsch's work with bees to the problem of insect migration. Although the flights of bees are of relatively short distances, their use of polarized sky light as a navigational tool may have wider application.

This book fills a void in the literature of natural history and is required reading for everyone interested in entomology and the wider field of animal behavior.

WILIAM HAYWARD LOERY

ENJOY YOUR CHILDREN, by Lucille E. Hein.* Abingdon Press, Nashville, Tennessee. 1959. $3.50.

"What can I do now?" How often that cry is heard, not only when a child is ill, but on a wet day during holidays, or when an expedition has had to be canceled! Miss Hein offers many helpful suggestions for harassed parents or bored children. After a mother has studied these pages the home should hum happily with easily organized activities . . . in fact, a mother might be inspired to copy the answers to "What shall I do now" and pin them over the kitchen stove or the sink, or post them on the kitchen bulletin board. The recreation and activity ideas are for 7-to-12-year-olds.

DOROTHY M. HALKERSTON

MORE ABOUT BOOKS

PIGS, TAME AND WILD, by Olive L. Earle.* Morrow Junior Books, New York. 1959. $2.50.

There may be many people in the world who sincerely like pigs on the hoof, but our guess is that there are many more who find them more attractive as pork—properly cooked. But pigs have a champion in Olive L. Earle, who, incidentally, made us do a similar volte-face about mice. Her latest book defies a grown-up to put it down until it has been read from cover to cover (it is only 64 pages long)—and then "pigs, tame and wild," have found another friend. Authentic information, written around Miss Earle's charming drawings, make this little book a worthy addition to the list of her attractive works for children.

SECRET OF THE SAMURAI SWORD, by Phyllis A. Whitney.* The Westminster Press, Philadelphia. 1958. $2.95.

Very pleasant reading for girls of twelve and older is this story of the adventures of American Celia and her brother Stephen during a summer vacation with their grandmother in Japan. Mystery and suspense involving a "ghost," the frustrations of an aristocrat of old Japan and his

* Staten Island resident.

nisei granddaughter, and the expeditions of the young American visitors, all against a background of everyday life in Kyoto, combine to hold the reader's interst. Miss Whitney, who was born in Yokohama and lived in the Orient until she was fifteen years old, has written with sympathy and skill about two races whose children, given the opportunity, may gain a friendly understanding of one another.

THE MOONFLOWER, by Phyllis A. Whitney.* Appleton-Century-Crofts, Inc., New York. 1958. $3.95.

The bombing of Hiroshima and Nagasaki and the sinister effects that brought tragedy to many Japanese and indirectly to some Americans underlie the story that Miss Whitney has woven around the attempt of an American girl to salvage her marriage to a scientist. A sense of mystery and futility is built up to a climax and unexpected conclusion. Its basis makes it impossible for the book to be a happy one, but Miss Whitney leavens the theme with a generous sprinkling of descriptions of ceremonies and landscape that give a keen sense of tradition and beauty that are essentially Japanese.

THE LIVING FOREST, by Jack McCormick. Harper & Brothers, New York, in cooperation with the American Museum of Natural History. 1959. $3.95.

". . . drawn from the exhibits in the Hall of North American Forests and from the background information compiled during the preparation of the Hall"—beautifully and helpfully illustrated by Matthew Kalmenoff, this is a book that any forest-lover can read with profit and enjoyment. A teeming world is revealed right from the start. Mr. McCormick says: "The number of organisms in each square foot of the forest floor may be four times as great as the human population of the earth!" And he deals with all the levels of the forest. Chapters on animal life, tree diseases, and the effect of sunshine and rain are followed by fascinating stories told by tree stumps. A general description of the forests of North America, the ways in which they are changed by nature and treated and used by man conclude a book that leaves the reader with an urge to visit the Hall of North American Forests in the American Museum of Natural History.

QUOTABLE QUATRAINS, by Eldridge Peterson.* Charles Francis Press, New York. 1958. $2.00.

Once in a while we have the privilege of reviewing a book by one of our members. This time the member is a Trustee of our Institute. His verses add a lilt, some smiles, condensed philosophy, and a few deeper thoughts to our library. The book is one to be enjoyed at odd moments—whatever one's mood—somewhat the way one takes any by-road that looks inviting, just for the fun of it, never knowing what is beyond the next turn.

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* Staten Island resident.

OUR CONTRIBUTORS

DOROTHY M. HALKERSTON

Tasmanian writer and naturalist; stories published by British magazines and used by B.B.C. Worked in Botanic Gardens at Kew during World War I. Member of this Institute and volunteer worker in our library.

PERCY A. LEASON

Fellow and life member of this Institute; Fellow of Royal Society of Arts, England; painter, lecturer, and writer; student of aboriginal art; former president of Section of Art of this Institute. Exhibited in National Academy of Design, New York, and has work in national and private collections in Australia, England, and America; elected to Allied Artists, Audubon Artists, and Salmagundi Club.

WILLIAM HAYWARD LOERY

Vice-president of the Section of Natural History of this Institute. Physician; pathologist at College of Physicians and Surgeons, Presbyterian Hospital, New York.

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Curator of Science of this Institute.

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